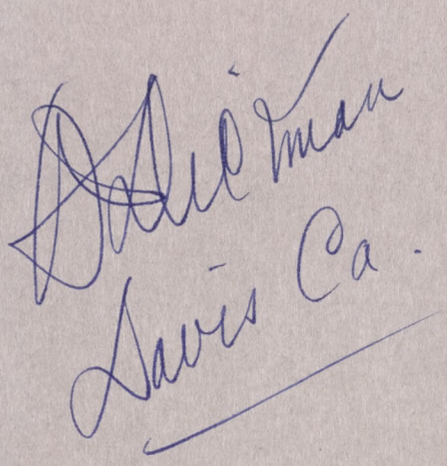

The Oral History Center

INTERVIEWS WITH PERSONS INVOLVED IN THE DEVELOPMENT OF THE MECHANICAL TOMATO HARVESTER, THE COMPATIBLE PROCESSING TOMATO AND THE NEW AGRICULTURAL SYSTEMS THAT EVOLVED.

A. I. Dickman

Interviewer -Editor

Marvin Brienes
Co-Editor

STATEMENT OF EDITORIAL PURPOSE

The procedures of our oral history projects include not only the tape recording of interviews but also their transcription, editing, and eventual production in bound form. What is presented to the reader is a version of the spoken word, not the written word, a technique that provides much of the intimacy, candor and spontaneity of the work. However, standard and recognized editorial techniques are used to maintain a consistency of style throughout all oral history publications. Since basically each title is for University archival deposit, such matters as dates, names, places and scientific terminology is presented with the utmost accuracy possible. Editors rely upon the Chicago Manual of Style (1969) and the project's own style sheet to maintain an optimal printed version of the spoken word.

The History of the Interviews explains the motives and purpose behind the gathering of the interviews and it also lists the names of the interviewees and a brief abstract of their contents in the order that is followed in the work. therefore no additional Table Of Contents is provided.

The interviews were conducted 19 1975

HISTORY OF THE PROCESSING TOMATO ORAL HISTORY INTERVIEWS

California produces 85% of the tomatoes canned in the United States. The processing tomato industry with its related industries such as trucking, fruiting, shipping, can and glass container manufacturing etc. contributes an estimated three billion dollars a year to the economy of California and creates thousands of jobs.

Yet this huge, vitally important basic industry would probably not be in California today except for the University of California at Davis research and development of the processing tomato which could be mechanically harvested, the development of the mechanical harvester itself, devising an entirely new system of growing, seeding, irrigating, fertilizing, weeding the new variety, and finally developing a revolutionary system for loading and transporting the vastly increased quantities of the fruit.

For a number of diverse reasons including the difficulty of obtaining domestic farm labor in war-time, and the arduous work of tomato hand harvesting, domestic workers traditionally were in very short supply.

The problem of finding enough tomato pickers to harvest the crop had been solved over the years by hiring foreign nationals, particularly Mexicans through various government sponsored programs of which the best known was the so-called bracero program.

The bracero program faced mounting opposition from several public sectors particularly from organized labor and religion, and finally the program was cancelled on December 31, 1964.

A desperate attempt to recruit domestic workers to replace the braceros failed miserably. Without labor to pick the tomato crop in California, obviously the crop would have to be grown elsewhere. The processors looked toward Mexico and one or two had already moved their tomato canning operations there.

It is generally conceded that UCD research and development dramatically saved this industry for California.

The Oral History Office at UC Davis was given a grant of $2500 from the California Tomato Growers Association to interview the principal figures in this history so that future generations of scholars, farmers, students and others would have the benefit of their verbatim recollections.

While the research and development done at UCD was critical to the success of the project, not all of the major figures were on campus by any means. Several growers, mechanical harvester manufacturers, California State inspectors and others were also interviewed and recorded.

These persons interviewed do not include all of the principal figures involved. For various reasons including the scarcity of funds, the oral history effort was limited in scope and does not include all of the key figures.

Edited transcriptions of the taped interviews were accomplished on the following persons:

1. Gordie C. "Jack' Hanna

   The UCD geneticist who almost single-handedly, over a period of some twenty years, successfully bred the revolutionary new variety of processing tomato which was machine compatible.

2. Coby Lorenzen - UCD agricultural engineer

   Lorenzen working closely with Hanna in determining what the machine would be required to do, developed a prototype machine which was successfully field tested.

3. Ernest Blackwelder, Sr. - mechanical harvester manufacturer

   The small Blackwelder Company was willing to gamble on an untested machine in an untested market whereas the large farm machinery manufacturers backed off.

4. Lester Heringer - grower

   The tomato grower who saw the certain end of the processing tomato business in California without a mechanical harvester and gambled $15,000, to order the first machine from Blackwelder.

5. Michael O'Brien - UCD agricultural engineer

   The new mechanical harvester required a fresh approach to a system of loading and grading which could handle the vastly increased tomato production: O'Brien and his colleagues developed and continuously improved this revolutionary system.

6. Robert L. Button

   A tomato grower of Winters, California, mechanically inclined, developed his own harvester which was then manufactured for sale by the Johnson Machine Company as the Button-Johnson harvester.

   Button died in a small plane crash before editing and releasing his transcribed interview. The lawyer for the Button estate released the manuscript.

7. Robert L. Hartzell

   A canning company official who was present at the trials of

the UCD mechanical harvester prototype and whose company, Tillie Lewis Company, purchased one of the first Blackwelder harvesters, recalls his experiences.

8. Eugene Winters

A tomato grower talks about his pre-mechanical harvester hiring experiences using American Indians as tomato pickers.

9. John Miller

The State of California provides an inspection service for both grower and processor, dating back to 1941. One of the first inspectors recalls his impressions of those times.

10. Raymond Roth

A State labor official familiar with the problems of recruiting domestic and bracero workers gives his recollections of the pre-mechanical harvester labor situation.

11. Robert Underhill

The first mechanical harvester was known officially as the University of California-Blackwelder harvester. The University vice-president in charge of patent rights relates the patent story.

12. George A. Johannessen

Manager of the Processing Tomato Advisory Board, he describes the evolutionary growth in production and research in the processing tomato industry.

13. Albert Jongeneel

The experienced farmer from Rio Vista who developed one of the first sugar beet harvesters urges his friend "Jack" Hanna to commence the work on breeding a machine-compatible processing tomato.

14. Charles Rick

A professor in the Department of Vegetable Crops with an international reputation for his work in vegetable genetics and improvement. He travels the uncivilized areas of the world obtaining wild vegetable species and breeding their desireable characteristics with domestic species.

15. Mel Zoble

Yolo County Cooperative Extension representative working with the Department of Vegetable Crops and with processing tomatoes in particular, who was in on the changing cultural requirements for growing the new variety tomato and was a key figure in advising growers on the new methods.

16. Roy Bainer

Chairman of the department of Agricultural Engineering who arranged for Ag Engineer Coby Lorenzen to team up with geneticist Jack Hanna in the development of a processing tomato mechanical harvester.

Credits:

Special appreciation and recognition is given to many faculty and cooperative extension persons for critically reading and reviewing the oral history transcripts.

Dr. William L. Sims, Cooperative Extension, Vegetable Crops, provided valuable suggestions and made corrections. He also aided in identifying old photographs and loaned several photos of his own.

Robert Pearl, Cooperative Extension, Food Science and Technology, observed that the interviews do not include key persons in food science who worked with the new tomato varieties for solids and for other characteristics desired in processing.

Dr. Charles Rick, Vegetable Crops department, and Dr. Michael O'Brien, department of Agriculture Engineering, gave suggestions and made corrections that improved the work considerably.

The California Tomato Growers Association provided the modest grant that funded this oral history effort to record the recollections of many of the key persons who were involved in the activity.

The Editor-Interviewer assumes full responsibility for errors, whether of omission or commission. All of the persons interviewed gave freely of their time and talked with candor of their experiences. It is hoped that their views will add measureably to the history of this subject.

A. I. Dickman
Editor-Interviewer
Oral History Office
U. C. Davis

GORDIE C. HANNA

Background and Education

Hanna: I am Gordie C. Hanna, usually known as Jack Hanna. I was born July 1, 1903, at Quannah, Texas, where I lived until I was about seven years old. Then we moved up into Floyd County where I remained most of the time until I came to California in 1924. I went to grade school there; finished up high school at Norman, Oklahoma in 1922; went one year to the West Texas State Teachers College at Canyon. In 1924 I started at Berkeley, spent one year there, and then moved to Davis in 1926 and I've been in and around Davis since that time, with the exception that I spent twelve years at Ryer Island on asparagus. However my headquarters were always here at Davis in the Department of Truck Crops, as it was known in those days.

Dickman: What is your academic training?

Hanna: Well, I finished the B.S. degree in 1928--Christmas, 1928--and went to work on Ryer Island the first of January, 1929. I spent one semester at Davis doing graduate work, and the fall semester in Berkeley in 1932 doing further graduate work, completing all of the course requirements for a Ph.D. However, since I was located at the time on Ryer Island, there was no place to do any experimental work necessary for graduate work; therefore, I stopped my formal training and never did take it up after that.

Dickman: If you had gotten a Ph.D., what field would it have been in?

Hanna: It would have been in genetics.

Developing the processing Tomato

Dickman: When did you first get interested in the tomato plant?

Hanna: I didn't get really interested in that until 1938, I believe it was. When I was on Ryer Island asparagus was the only crop that I was working with. And then it looked like I needed something else to fill in for work since most of the asparagus work was completed by the first of July or shortly after that. Therefore I began working on tomatoes as a second crop. And then I commuted between Rio Vista, where I was living at the time, and Davis, doing the work here in the autumn.

Dickman: Did you have any idea at that time of developing a tomato to be harvested mechanically?

Hanna: No, I had no idea of working on the tomato harvesting problem. Although very little work had been done--practically nothing--I was looking around and thinking about it. Actually, I had started working on mechanical harvesting of asparagus at that time.

Dickman: Incidentally, that's pretty well along now, isn't it, mechanical harvesting of asparagus?

Hanna: No, it's been pretty much of a failure. I only know of one successful venture, and that's going on now in Australia.

Dickman: When did you first begin to think of developing a tomato that would be able to be harvested mechanically?

Hanna: Well, the idea was given to me by A. M. Jongeneel, known as "Fum," in the fall of 1942 (I believe it was). At the time he had some tomatoes and he couldn't get any pickers. I happened to be down there, stopped in to see him, and he wanted to know what I was doing about tomatoes, and I told him the usual thing. He said I should be working to develop a tomato that could be harvested mechanically. I proceeded to tell him why that was impossible. And then he proceeded to literally wipe up the floor with me. He told me that with all the brains that were up here at Davis and all the tomatoes from all around the world, there must be some way of putting them together and coming up with a tomato that could be harvested mechanically. I think that, had it come from any other man, I would not have paid any attention to it. But he was the man who really developed the first successful sugar beet harvester.

I was somewhat conditioned for this approach, I think, because I got interested in the history of asparagus and found out that the first asparagus harvesters or cutters were Chinese, brought over here in the Gold Rush days. The next cutters were the Japanese. They were replaced by the migrating Italians and Portuguese, and then we had the Hindus come in. And later the Filipinos came in. Then I began looking at the labor of the other vegetable crops in

Hanna: California and found that it was mostly done by imported nationalities and it looked to me like we were running out of nations to import to do our work. That's why I think this had quite an influence, along with Jongeneel's statement, so I felt that we had to somehow or other start in and develop a tomato that could be harvested mechanically.

Dickman: Was Jongeneel actually afraid that labor was going to give out at that time?

Hanna: I don't recall, but he could not get any help at all at the time and there was a big demand for tomatoes. I think they were paying eighty-five dollars a ton for tomatoes at the time (these were market tomatoes). He had a crop, terrific price, and no one to harvest them.

Dickman: They weren't using wetbacks at that time?

Hanna: No, this was during World War II. There were wetbacks around, I guess, but they certainly weren't available. The whole labor organization was really not very well organized, at that time. What labor was available was mostly working in the sugar beet fields, that time of the year. There was competition for labor for sugar beets and tomatoes. The tomato acreage at that time was, I don't recall exactly, but it was around thirty-five or forty thousand acres and the yield was, approximately, seven or eight tons to the acre.

Dickman: Didn't the sugar beet labor situation ease up a little after Roy Bainer* developed seed segmentation?

Hanna: Oh, yes, but it took several years for the sugar beet industry to become mechanized.

Dickman: But the seed itself . . .

Hanna: Oh, yes, yes. That saved thinning labor, but not so much harvesting labor.

Dickman: Well, now that you had the idea for tomato mechanization, where did you start?

Hanna: At the time, we had a rather large collection of tomatoes that were collected in various parts of the world. This work was done by the

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*Dean of the College of Engineering, UC Davis, 1962-1969.

Hanna: USDA [United States Department of Agriculture]. And we had this collection growing here at Davis. I looked these over with the idea of trying to find something that I thought would harvest mechanically. I had one tomato, rather large-fruited but rather tough. Large fine; the yield was rather poor. But I found that I could drop this tomato from a height of about three feet out in the field on the ground without it breaking. That is, I could drop it once, but the second time it usually broke, and if not the second time, it always broke on the third time. So this, as far as firmness was concerned, was quite superior to anything else that we had at the time. I made a number of selections of this and carried it on for two or three years, but I never could improve the percentage of ripe tomatoes on the vine at one time. By the end of, or during, the summer of 1947, after I'd really been looking at this for some five years, I hadn't arrived anywhere at all with it.

Dickman: What were your specifications? What did you need?

Hanna: We didn't know (laughter), since we didn't have a harvester. I had talked this over in the meantime with Jim Fairbank* and later Roy Bainer, and we knew that this tomato would be handled rather roughly by the machine. We had no concept really of what the machine would be, so, since there was no work done on it (this was during the war, there was absolutely nothing that could be done). We really didn't have any concept other than I thought that the tomato had to be rather firm and probably be able to stand considerable rough handling. And I might say that I started work on the tomato about two years before I dared tell anyone in my department that I was working on it. And, when I did, you'd be surprised at the funny looks that came on their faces and they tried to talk me out of it.

So, in 1947 I decided to see what other people were doing. I took a trip around the United States and stopped at some twenty-two stations, talking to men, what they were doing, how they were going about their work, and so on. I found out rather readily what they were doing and some of them began to ask me what I was doing on this trip; what was the purpose of the trip, and so on. I told the first few that I was looking for ideas on how to develop a tomato that could be harvested mechanically. Well, after a few rather questioning looks and terminations of conversations as though I wasn't worthwhile talking to, I learned to stop telling them what I was after. Then I began to make some headway; that is, getting information about what they were doing, how they were going about it and so on.

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*James P. Fairbank, then an Extension engineer, UC Davis.

Hanna: But it wasn't until I got to Geneva, New York, that I found the idea of mechanical harvesting that paid off. I was talking to Professor W. T. Tapley, who was doing the breeding work. He had no concept at all of mechanical harvesting, but his work gave me the concept. He had planted tomatoes on some very poor soil, and the one that particularly caught my eye was a cross between Gem and San Marzano, which was later developed into the variety Red Top, but it was growing there on very poor soil. These little plants had three or four tomatoes on them and they were standing up like pine trees. Well, as soon as I saw those I thought well, this is what I'm looking for. I can grow these very thickly and somehow or other we can mow these and shake the fruit off.

This gave me the idea of a small plant that would limit the set where all the tomatoes could be ripe at one time. And this is the concept that we've carried ever since then. He told me the parents of this cross, so I came home and made the cross. I believe it was in 1948. I had the F-2 generation out in the field, but they didn't grow up like pine trees at all. They were very susceptible to verticillium, and our soil was loaded with verticillium. So instead of little pine trees sticking up in the air with its fruit off the ground, we had little piles of sunburned fruit down the row.

The next job, of course, was to put the verticillium resistance into these strains, which took several years, and we later came out with a variety which is known as Red Top 9. I did this by back-crossing the verticillium-resistant segregate to Red Top which I'd obtained in the meantime. This was the first variety released for mechanical harvesting, although at the time we didn't have any harvesters and it didn't get very far because it was not a very good yielder. Later we began using some round material, which I had picked up here and there, some of my own and I got one small-fruited firm variety from Paul Smith who breeds market tomatoes. I used that in the breeding work; most of the derivatives of my own were crosses between Santa Clara, Piminellifolium and Pearson. This small-fruited thing of Paul Smith's was early, and it became then the forerunner of the lines that were later developed into mechanical harvesting lines. Well, this brought it up to about 1960, I believe.

In 1961 I planted some 248 lines out in the field. We had very high temperatures during July and early August, and most of the varieties or strains that I had in the field didn't set at all. But there was one particularly good-looking line in 1960, and from that I had made a large number of selections--I think 47. Every one of them set quite well during this high temperature. There were two other families besides these. One had 3 strains, and the other one had 5. They all set, too.

Hanna: Well, line 145 was by far the best from a horticultural point of view, so we saved two of those and sent the seed down into Mexico with Peto Seed Company. They grew the seed down there in the fall and winter of '61. And then we brought some two hundred pounds of seed back and gave them to the trade for 1962 planting.

Teamwork with an Agricultural Engineer

Dickman: Let me take you back just a bit before this. When did you first team up with Coby Lorenzen?

Hanna: Coby had been assigned by Roy Bainer as the project engineer on this thing. I don't remember just when--sometime during the war I guess--when Coby returned to Davis. Anyway, he was very busy teaching and had a lot of other work, and since there was no demand at all by the industry for this mechanical harvesting, there was nothing done about it.

After I came back from the East, I said, "We're going to harvest tomatoes mechanically." I had some San Marzanos in the field and I cut the vines back until they would go through a potato digger. I took the potato digger out in the field and started down the row. I removed about 80 percent of the tomatoes. Of course the clods smashed them, but at least I got the tomatoes off the vine. I came in, got Coby and took him to the field and showed him what I'd done. Well, he took one look at the work; we started up the potato digger again, and as he saw it in action he said, "This is the wrong principle. You should leave those clods on the ground; that's where they belong, not up in machines." I said, "This is your area. You take over."

Dickman: Well, let's see. You had to have a tomato that would mature all at the same time; that was firm so that it could resist the hard handling of the mechanical harvester. What other requirements did you have?

Hanna: Well, this tomato had to come off the vine easily, we thought, because we didn't want to shake this tomato too hard. Coby and I sat down in my office one day and drew up the specifications. He said the machine had to cut the vine, had to pick it up, had to shake the fruit off, and deposit it (the fruit) in a container. He forgot one very important item that the machine had to do, and that was throw the vine away. Believe it or not this was one of the greatest difficulties we had to overcome. That vine would wrap around everything and it wasn't until we stopped trying to control

Hanna: the vine and let it do whatever it wanted to in the machine, that we began to make headway.

The first proto "Rube Goldberg" harvester, Coby finally put together in the fall of '59. This was the first harvester that went to the field to harvest tomatoes except for his experimental machines. After this (I don't remember--sometime in October), we had this test down on Les Heringer's ranch in the Clarksburg area. That night I came back and I called Ernie Blackwelder, and told him that we had a machine that looked like it would go and he ought to come up. He said, "When shall I come up?" I said, "How about tomorrow morning?" He said, "I'll be there." So, we had this meeting, and we went on from there.

Dickman: Where were you getting your funds all this time?

Hanna: We didn't have any. Actually, until the variety was released, and Blackwelder had taken the original machine and began working on it, we never had any funds with the exception, I believe, that the Tomato Growers Association donated $500.

We had a small planting down to the Imperial Valley that we used to take the machine to during the summer in order to speed up the work down there. That gave us an extra season. We'd go down about the first of July. We'd go down there and I'd try the machine which, of course, didn't work. We tried to figure out why it didn't work, and it was that day and a half going down there and the day and a half coming back that Coby and I spent together in the car, without any telephones or anything else to disturb us, that I think we made the most headway in our thinking.

You see, we started far apart. I was out here trying to develop a tomato on one end; he was trying to develop a machine. Neither of us had a concept of the other's work, and neither of us had a very good concept of our own. So we were way apart, trying to meet. And each time I would try to make some change in the tomato, or project a change, this would interfere with Coby's work, of course. Finally we got together on it, apparently at the right time. But this was the big part.

Dickman: In your collaboration with Coby Lorenzen, as far as you know, was this the first time that an ag engineer and a plant breeder worked so closely together?

Hanna: So far as I know, it was; I don't know of any other incident. But I don't know why it didn't happen before, because the two fields are rather wide apart in basic knowledge, and so one man couldn't be expected to know both of them. And why not team up on a problem like this? I think both sides have to give a bit and learn a

Hanna: tremendous lot about some of the other aspects of the whole field of growing and handling crops, and harvesting.

Dickman: You had to learn a lot more about ag engineering than you ever knew?

Hanna: Well, I think Coby gave me a concept that I never would have gotten from any horticulturist or geneticist--the fact that a tomato wasn't necessarily a tomato with him, it was merely an object that had certain physical properties. And in order to harvest it the job was to remove this object from another object and convey it over into a container. And what is the easiest way of doing this? That's how he looked at that. And, he taught me to look at a plant mechanically, much more than I'm sure I ever would have gotten from any horticulturist.

Dickman: What did he learn from you?

Hanna: I really don't know, other than he got the concept, I think, that it takes a long time to develop something new in a plant. And he said, many times, that this plant when you put it out there, changes from day to day, whereas a machine you can walk away and leave for months and come back and find it exactly as you left it. This isn't true with a plant. And this, I think, he really learned while he was working with the tomato.

Dickman: Who is carrying on the work now?

Hanna: So far as I know, there's no one in the University that's actually doing the work that he did, whereas Dr. Alan Stevens has replaced me.

Dickman: What is Mike O'Brien doing over in ag engineering?

Hanna: Well, Mike O'Brien didn't work on the machine itself, he worked on the bins and the handling of bins, the sampling devices needed to sample the tomatoes and so on. And he worked also on the central sorting.

Dickman: In connection with this collaboration between you, a plant geneticist, and an ag engineer, are there any other examples of similar collaboration later on in any other field?

Hanna: Yes. We have one with lettuce. Mike Zahara in our department is working from the plant point of view and Roger Garrett, over in engineering, is working on the machine. But they work together. And, I know in the development of the grape harvester, ag engineering worked very closely with viticulture, members of the viticulture department. So it looks like we started something. I don't know why it wasn't started a long time ago.

Industry Problems

Dickman: Do you recall the reaction of the canning industry to your accomplishments?

Hanna: Yes. We had a complete lack of any cooperation from the industry. And even after we got the harvester in the field the canning industry was very reluctant to accept these tomatoes. One of the reasons was, of course, that the growers themselves had to learn how to handle these tomatoes. A once-over harvest was entirely new to them. The handpicked varieties were normally irrigated just before harvest, which would carry the vines through for the second or third harvest. And, in these mechanical once-over harvests, they were still irrigating for that third pick. Consequently the tomatoes were very soft, and there was a lot of breakage, very dirty tomatoes, and so on.

One of our first concepts was to get a tomato that would come off the vine easily. Well, we've got them coming off the vine too easily. And so there's a lot of shattering in the field as soon as the cutting blade hits the vine. It shakes the vine to some extent, and a lot of the tomatoes fall off at that time. We've developed tomatoes that will not shake off as readily, so some of them stick on too tightly. It takes a lot more energy in the tomatoes to shake them off. And some of the vines we leave tomatoes on have perfectly good tomatoes, maybe a half a ton or a ton to the acre.

This, in the minds of growers, is very bad because this is a loss. They overlook the fact that they're losing five or six tons or more scattered, and green tomatoes on the older varieties. But that is normal so they don't think anything about it. These tomatoes, ripe tomatoes on the vine in the field, is very bad.

One of the companies that did make a success with this was Heinz. I remember Oscar Hayes said to me, "Jack, we don't like anything about mechanical harvesting, but we've decided that it's going to be here to stay, and we've learned to live with it." Contadina and Tillie Lewis also entered into this very quickly, and they were desperately trying to make this thing work. This was, of course, in the early sixties after we had developed the machine to a workable stage and I had a variety that would work somewhat. If we'd had more help earlier in the preliminary stages, I think we could have accomplished this sooner. You asked about funds--well I didn't have any funds specified at all for mechanical harvesting. I had a few rows over at the side of the field which I didn't tell anybody about. That's where I got my funds.

"People" Problems

Dickman: What other problems were there?

Hanna: Really people problems (laughter).

Dickman: What were they?

Hanna: Well, no one believed in this. We had absolutely no help.

Dickman: Who was the chairman at that time, of the Department of Vegetable Crops?

Hanna: J. E. Knott, and of course his background was market gardening in the East, and to think about harvesting tomatoes mechanically was just beyond his conception. But he wasn't alone. I was the only one in the department that even thought we could do it. Now, I think there were quite a number of people in agricultural engineering that thought it could be done, but they didn't know anything about tomatoes. And if you don't know anything about tomatoes, all the problems seem mechanical; they had no handicap, really. But to some of the growers, some of my very good friends, I knew them and they knew I was working on it, but they would never even mention it. One day I had brought up the question of mechanical harvesting with two grower friends and they looked kind of funny; the subject was quietly changed. So I never dared bring it up within the industry after that.

Dickman: Not even to Jongeneel?

Hanna: Oh, well, yes, I talked to him. But he was not growing tomatoes at the time. I think he'd only had that one venture until years later, after the machines were developed. I talked to him occasionally about it, but of course he didn't know anything about tomatoes either. This problem didn't seem insurmountable unless you understood the problems involved.

This was the big joke of the industry for some time, when they learned we were working on the tomato. And then they had labor trouble from time to time and the evolution of their thinking went something like this: "Well, the thing is impossible." Then, after they began talking about it: "Do you think you'll ever get anywhere with it? Well, how are you getting along?" And then: "When are we going to have one?" Finally in 1959, when they had a lot of labor trouble, they said: "Well, we've got to have it! Get off your backside and go to work!" (Laughter.)

Dickman: And you'd been working on it since about 1947?

Hanna: Well, thinking about it, really, since 1942. So we're kind of slow (laughter).

Dickman: When did the bracero program phase out?

Hanna: This was about 1966 or '67. They started phasing out before that, then there were threats of phasing out, and I think that Secretary [of Labor, W. Willard] Wirtz used the fact that we had a mechanical harvester here in California in order to turn that program off. Now there's a lot of people very bitter about Wirtz. Actually Wirtz did the tomato industry in California a tremendous service in cutting off that program, because as soon as he cut that program off, our acreage and yield with mechanization began to jump.

Dickman: Has your research affected the market tomato?

Hanna: Oh, they are working on this and have been for some time. There's one variety, I believe in Florida, that's being harvested mechanically. I don't know too much about it. There's been some complaint, but I think primarily newspaper complaint. But they have more people problems than we have in the processing industry, so I would expect them to go rather slowly in that.

The vegetable industry started in the backyard. The housewife took care of the garden usually, and when she wanted vegetables she went out and harvested them. Most of this was done on a day-to-day demand. Well, this was a small plot. Then we had a market garden, which was really a backyard garden enlarged, and then we went to the field. But along with this we took a lot of the backyard garden philosophy with us out in the field. We really never considered the vegetable industry as a field venture like the grains, which became mechanized rather early. And so it's this backyard philosophy that's been hampering the whole industry. And this is largely true with the tree fruits, I think. It's rather difficult to get rid of these traditional concepts of growing and handling fruits and vegetables. That's been really the great drawback to the whole mechanization program.

Breeding Work

Dickman: Getting back to your own work, when you came up with a tomato for mechanical harvesting, you must have had a lot of experimental fruit that you developed along the way.

Hanna: Most of my breeding work was done for hand harvesting, and it was only off on one side that we had any work at all for mechanical harvesting. You might say that 95 percent or more of our effort was developing handpicked varieties, and we developed a number of those: VF 36; prior to that we had a VF Pearson 6 and 11 and VF 36 and VF 34, and VFN 8 was the last one I released. Oh, yes, there was another one in there: VF 14. Those were all handpicked varieties. Incidentally, the warm spell we had in 1961, where most of the commercial varieties were not setting, VF 36 set very well. That's a handpicked variety, and that was the year that really separated it out from the others, and gave us an inkling of what we had to have.

Since mechanical harvesting is a destructive harvest, it requires periodic plantings in order to have tomatoes over a long period of time. So we had to have a variety that would set under any conditions here in California, and that variety was planted and had to remain in its place in this chain. Otherwise it would have been rather disastrous had we had a hot spell and delayed setting on one planting and brought two plantings in together. This is why, in 1961, I selected the 145. That was not my favorite at the time. One of my favorites was 206, but it didn't set at all during that hot weather, so that was eliminated. It was very fortunate that we had this very high temperature in 1961 to separate these varieties out at the beginning of mechanical harvesting.

Dickman: Was there a Tom Thumb variety?

Hanna: Not Tom Thumb, but we had--it's a windowbox variety--Tiny Tim. That was used, and then later I used one Hardin's Miniature, which has the ability to elongate a tomato. It's a very small tomato itself, about roughly an inch long, the larger ones, and half an inch in diameter. It's rather a pear-shaped variety but when crossed with some of the pear shapes, it elongates that pear.

This is another thing we found very quickly in harvesting: the pear shapes such as Red Top and San Marzano handle much better than any of the rounds. We couldn't understand why at first, so we took a high-speed movie of Red Top coming off the belt. We found that these tomatoes, due to the vibration in the machine, oriented themselves at right angles to the direction of movement of the belt. And when they come off the end of the belt they land on their side, having a greater area of contact to absorb the shock, and furthermore they have a smaller diameter for a given weight and therefore they have better structural strength.

Dickman: Is this why I see some tomato fields nearby that grow the long tomato?

THE NEW VARIETY OF TOMATO, DEVELOPED BY JACK HANNA, COMPATIBLE WITH MACHINE HARVESTING

Hanna: Yes. These tomatoes will handle better, but there's another disadvantage to them. In the machine these tomatoes don't roll on the belts, they don't flow on the belts as fast as round ones, because of this greater area of contact which protects the tomato. But it makes it difficult for the workers. Furthermore, they orient themselves at right angle direction to the movement of the belt, and these tomatoes have to be graded. It's much easier to pick up a round tomato than it is a long one because when you pick up this long one, it means orienting your hand at right angles to the natural movement of the worker. So it's an extra movement on the part of the worker to grade these tomatoes--which they don't like of course.

Well, I had some segregating material in the field in rounds and longs, and we knew that the age of the fruit--that is, the length of time it had been ripe--would affect this handling ability, so it was necessary (in order to test this idea) that we tag fruits at given times and know how long they'd been ripe before we began a drop test on them. This we did by painting numbers on the fruits just at the incipient ripening stage, just as they began to turn red at the blossom end. We would paint a number on that; one day we'd use the number one and two days later we'd use (we were doing this every second day) two, three, four, five and so on. And then when we picked all these tomatoes at once, we knew how long they'd been ripe.

We segregated them into maturity dates, and then we separated them into weight classes also, and dropped them until they broke. We dropped these from a height of fourteen inches onto a desk. We found that the long tomatoes took about two and a half times as many drops to break as the rounds.

Dickman: Which tomato did you actually use for the first mechanical harvest?

Hanna: Well, the first we started out with was VF 145. There are a number of strains of those and that is still the predominant variety.

Dickman: Could you describe what it looks like?

Hanna: It's rather small; a roundish tomato, rather pointed on the blossom end. Normally it's about an inch and three-quarters in diameter both ways (horizontally and longitudinally) with a small stem scar.

Dickman: Now I'm a little confused. You liked that elongated tomato because it could resist a lot more force, but you wound up with a round tomato, the 145?

Hanna: Yes. We have some long tomatoes, but again, this is where people come in. Some of our people problems. A tomato is supposed to

Hanna: be round. Why? Because it's always been round. Therefore, we had a problem on our hands: how do you change the shape of this tomato--take out this stigma of a long tomato? The only thing that I could think of was to slice this tomato. And, if you slice the tomato, put it in a can, of course, the long shape loses its identity.

I talked this over with some of the people in food tech, and they said it couldn't be done. So I went back to my office in the field and I thought about this for about six weeks or more. I couldn't come up with any answer, so I went over to food tech again and they began to say, "No!" But fortunately there was a technical assistant there named Dasha Trombopolis, sitting and listening. She finally said, "Jack, I think this will work." I said, "Fine, Dasha, let's try it." She wanted to know when, and I said, "How about tomorrow morning?" She said, "I'll be ready."

I told her that she'd have to fix up the formula for this and so on, which we did. We processed these tomatoes about six minutes the next day. We opened the can and they didn't look like they'd even been cooked or anything. Then, one of the men saw this who had first said that it couldn't be done. His eyes began to bug out, and he quickly changed his point of view.

Now the industry got interested in this to some extent. They'd be interested in it more, but again, people are not taking too kindly to this sliced tomato in a can. Why, I don't know, except that they're used to looking at this round tomato. But there is now a definite trend towards the stewed pack, not the sliced tomato as we envisioned it. The stewed pack is gaining popularity rapidly; and, in this, these firm tomatoes come into play.

Because there's a lot less leakage of the tomato after they've been sliced by the machine, the case yields are much higher than with the round tomatoes such as VF 145. So we're coming back and reexamining this and, of course, the case yield is a mighty big factor in changing the concepts of some of these processors.

More Industry Problems

Hanna: This reminds me of another point that the industry complained about. Since there's a shortage of whole-pack tomatoes, and that whole-pack tomato commands the highest price, each canner tries to whole-pack as much as he can. And the labor is such that they used to hand core these tomatoes, then they developed coring machines

Hanna: in which the tomato was placed in a cup. The coring device came down and took out the core. Well, the VF 145 was a much smaller tomato, and it required a lot more handling in the machines, and furthermore it was rather pointed and it didn't sit in the machine well. When the coring machine came down it would take a core, but usually in the wrong place, and they complained bitterly about this.

I looked at the core of this VF 145 and it practically doesn't have any core. The stem scar's very small, and only a small white area beneath the core. I usually had samples of my work to let the industry see what I was doing; I had the VF 145--two pans of them, one which I didn't core and the other which I did core. Much to my surprise, no one noticed this. I finally called attention to Bob Hartzell of Tillie Lewis and he looked at me and said, "What?" He looked at this for a little bit and went off immediately and came back with his boss, Lou Brown. They talked about it between themselves, and Bob got the head of sales of Tillie Lewis. I was talking to another man at the time, with one ear cocked over my shoulder, listening to Tillie Lewis, and I heard the salesman say, "God, we could sell this!"

They took off from that and began selling canning tomatoes without coring them. Incidentally, these uncored tomatoes stood up in the can much better than the cored tomatoes. They interested Safeway in this, and Safeway gave them a contract. Well, this started it.

Actually this was considered to be illegal because the FDA requirements say that the core must be removed. So Ira Sommers of the National Canners Association went back to Washington to see the FDA about it. They said, "Well, the law says that the core must be removed." Then they said, "It looks like you have already removed the core, so therefore it is legal." And then the smaller tomato immediately gained a better position in the industry's eyes.

More Improvements

Dickman: How did your final product compare with the old tomato in terms of solids, purity, and taste?

Hanna: The taste is not as good as the old Santa Clara canner. People have complained about this. It's not quite as good as the Pearson. The Pearson was not as good-flavored as the Santa Clara canner in my opinion, and I think most people's opinion. But this is really

Hanna: a cross, then there follows a lot of selection, and you test these strains out. I try now to keep my number of strains in the field down to about five hundred. That's about as many as I can manage during the season. However, by going into Taiwan, and I have some going into Italy, I can increase this. Growing them in Taiwan, and actually in Australia also, I can increase the number of strains that I look at during the year.

Dickman: Do you need a computer?

Hanna: No, I don't. I don't use a computer at all. In fact, before computers came into general use, I developed--more or less--the essentials of a computer, and I had set up numbers for evaluations. I gave each component factor a certain number and value that I thought was more or less correct for that particular desirable characteristic; I used this one year. After I began to add up the score of some of these, some of them had a very high score of over ninety, and they were culls. Others that were down in the low seventies were much better tomatoes. Therefore I concluded that my number assignment was entirely wrong. I began to juggle this to try to make it come out where I thought the best tomato would have the highest score, but I was never able to do this, so I finally discarded it. And even if I knew how to program a computer, I wouldn't need it because I'd have already solved the problem.

Dickman: Thank you.

ADDENDUM TO THE GORDIE C. HANNA ORAL HISTORY

I think Coby and I have a fairly good questimate of what it cost to the taxpayer in developing our concepts of mechanical harvesting and getting the show on the road. Several years ago, Marilynn Stein, our girl friday in the Department of Vegetable Crops, asked me what the cost was. I told her that I didn't have the faintest idea. If you know her, you would know that she wouldn't accept that kind of an answer. Then she began to dig into me. Finally, in order to get rid of her, I said that I would think about it. She said, "Well don't just think about it, I'll be back."

I pulled out of my files all of my annual appointments from 1943 through 1961 and added up my salaries for those years. Then I estimated the time that I spent on teaching, asparagus, sweet potatoes, and tomatoes. From my planting records, I knew just what portion was devoted to mechanical harvesting. I obtained from Jasper Laraway, our Field Superintendent, the average number of hours of tractor time and labor in growing an acre of tomatoes. From this I was able to calculate what I thought was a reasonable cost. I have forgotten the actual figure, but it was less than 8,000 dollars. Anyway, I rounded it off at $8,000. This looked very low to me, so I put in a 50% fudge factor and raised it to $12,000. Then for good measure I added another 25% fudge factor on this, which raised it to $15,000. This figure I gave to Marilynn. After about five minutes I got a telephone call from Coby. He said, "I just got a call from Marilynn -- how in hell did you come up with a $15,000 figure?" I explained just how I did and the fudge factors that I had put into it. He eventually came up with a $17,000 figure for his efforts. This made a $32,000 combined estimate. We got together and discussed it at some length and decided to add another $10,000 fudge factor which made a final estimate of $42,000.

Somehow, all of this got into the administrative hands, where I guess that it really hit the fan. I heard by the grapevine that they said it was utterly ridiculous. I have forgotten the administratives exact figure, but I believe it was something like $350,000, maybe it was less. Anyway, most of their cost was for work done after mechanical harvesting began. After it began to look like it

would become a success it seemed like just about everyone and his dog wanted to climb on the mechanical harvesting bandwagon. We couldn't fight them off with a stick. I still think that the $42,000 estimate is quite generous in the actual cost of development of the basic principles of the machine and the development of VF 145 tomato. Strangely enough, neither Coby nor I were ever called in to justify the $42,000 figure.

INTERVIEW WITH MRS. GORDIE C. "JACK" HANNA

"I had a houseguest once who was amazed to find me practically a widow each morning as Jack would be away by 3:00 AM to get to his greenhouse work on the campus. "But at this hour there's no one working on the campus!" "What do you suppose he does there?" And she raised an eyebrow suggesting perhaps I was all too trusting and naive.

I had become so used to this way of life that I accepted it along with being "just a housewife". It all started about 1929 when Jack invited me for a drive. We crossed the little ferry boat to Ryer Island which at that time was planted in asparagus - ten thousand acres of it! It was being cut white which meant no spear of grass showed, only row on row of beautifully cultivated peat soil which the all but constant wind could whirl in every direction. As we bounced along the corrigated levee road Jack said, "How do you think you'd like living here?" I didn't tell him but we lived there until our oldest child was ready for school. Asparagus took most of Jack's time; tests, records and so on. Then one day Jack said he must do something about California's tomato crop, so he became busier than ever.

One nice habit of his is that he likes to be home in the evenings but early morning is something else. All the years on Ryer Island in Rio Vista and also in Davis after 1941 he was up and at his tomato project any time after 3:00 AM. I wasn't in on the tomato work, I just tended to my knitting and let him go happily about his work. But I felt more or less like a lone widow much of the time. It took me several years to know soluble solids, viscosity and such matters so now I can share the honors which have piled up for "Mr. Tomato" and I have enjoyed the travels and visitors from faraway places with strange sounding names, as well as those nearer home.

One early morning when my houseguest was here the phone rang for Jack about 7:00 AM. It was Major Everts, Executive Vice-President of the Canners League, calling from San Francisco. I told him Jack was long gone. He would call at 6:30 AM, then at 6:00 AM, and finally decided there was no use trying to call Jack early in the morning.

I got used to having breakfast by myself and never worrying about what Jack was doing on the campus and I hope I convinced my visitor I had no need to worry, even though it is nice not to be a tomato widow or any other kind, I am sure.

I don't feel unrewarded for having been the silent partner in such a tremendous project."

COBY LORENZEN

Education

Dickman: Would you identify yourself and tell me about your background, your education?

Lorenzen: I'm Coby Lorenzen. I was born in Oakland, California, on November 30, 1905. I attended the University of California at Berkeley as a student of mechanical engineering. But the major was called mechanics at that time.

Dickman: What class was that?

Lorenzen: That was the class of 1929. At the end of that four-year period I went to what's now NASA [United States National Aeronautics and Space Administration], which was then the National Advisory Committee for Aeronautics. There was no space program (laughter) at that time. I went there as a junior engineer associated mostly with wind tunnel design. In fact, we built the first vertical wind tunnel in the country at Langley Field, Virginia, which was the principal research headquarters. After two and a half years there, I returned to the University to take some graduate work since I thought some additional theoretical work more closely associated with aeronautics would be advantageous if I were going back to Langley Field.

Well, I didn't go back to Langley Field; I got interested in heat transfer with Dean [Llewellyn Michael Kraus] Boelter and in 1934 I received a master's degree. During the time that I was at Berkeley as a research assistant, I designed and built a wind tunnel that was used in teaching and research for several years there. That was an interesting experience which gave me a little confidence in the work I'd done at Langley Field.

Dickman: Was it the same size as the wind tunnel at Langley?

Lorenzen: Yes, it was about the same size as one of their smaller tunnels. They had ten or twelve tunnels of various sizes at Langley Field.

Lorenzen: They went all the way up to what was called the propeller research tunnel, which had a fifteen or twenty-foot throat, which was pretty large.

And, incidently, several of the fellows I knew at Langley Field came out to Sunnyvale and started the Ames Aeronautical Laboratory in later years, which is still a NASA center there.

My First Job

My master's degree came in the middle of the Depression. I had a job for two years at the California Forest and Range Experiment Station, which is a part of the [United States] Forest Service and encompasses the research section. I was stationed part time at Berkeley and part time at Mount Shasta. That was an interesting experience, except that there was not much chance for development for those who were not forest service personnel. That is, the physicist, chemist, and engineer, and other personnel of that kind, represented service organizations. So the opportunities were limited. But in 1937 Professor Boelter suggested that I look into some work at Davis, and I met Professor [Harry Bruce] Walker. He was the chairman of the ag engineering department, which was concerned with an orchard heating project.

There'd been a freeze in the citrus districts of Southern California, and the University received support from the California Citrus Growers' Association--I believe that's what it was--to initiate a program that had a twofold objective: to develop an orchard heating program and to develop a smokeless orchard heater. Arthur Leonard, who was an employee of the Standard Oil Company at that time, had been loaned to the University to do some work on orchard heaters. He was at Davis when I came there. Incidentally, he developed the famous return stack-gas heater which has been used all over the country. It was, I think, a major contribution in this whole program. Bob [Robert A.] Kepner, who still is in the ag engineering department, and I, together with Dr. Fred [Frederick Augustus] Brooks, the leader of the orchard heater project, made up the principal part of this orchard heating research team.

We spent part of the time at Davis working on orchard heaters and part of the time at the Citrus Experiment Station at Riverside in the winter, doing orchard heating experiments. I remember Charlie Barbee, who was running the shop at Davis at that time, went down to Riverside and set up a network of thermocouples out in the orchard. We had a billion miles of wire running around (laughter). It was an interesting setup--trying to determine the heat balance in the orchard and measuring temperatures

Lorenzen: in the soil, and in the trees, and in the air, which were influenced either by the cooling of radiation frosts or by the different types of orchard heaters that we had put out in our experimental plots.

It was important to start an experiment when it was a very still night. You'd start at about eleven o'clock and then the temperature would gradually drop and level out at twenty-seven or twenty-eight degrees about two or three in the morning. And, if everything was still, you would start the orchard heaters, measure a heat rise, and you could determine the energy liberated by the heaters and its distribution in the orchard. Fred Brooks was interested in measuring the temperature up to fifty or a hundred feet above the ground. He used a balloon, and he'd get out on the deck of the small house we had there, fill the balloon with helium, run it up in the air with a thermocouple on it and measure the temperature of the air from the ground all the way up to fifty or a hundred feet and get a temperature profile. On a really cold night you'd have to get down and stand by one of the orchard heaters in order to thaw out (laughter).

We had an acre of test plot. You'd have to run around with this orchard heater lighter and light these orchard heaters in just about as short a time as you could. It would have been nice if you could have pressed a button to get them all started at once. Then you'd have to run around and close them when it was time to stop the experiment.

We had instruments to record the temperatures in certain parts of the test plot, and we had to keep those recorders going. We had a mechanical system which would automatically switch from one thermocouple in the orchard to another so that we would get these points repeated, because we couldn't continuously measure every one of these manually. Well, we took miles and miles of recorder tape. I think Bob Kepner spent hours and hours transferring that data on to curves and tables. I think we collected enough charts in one season to provide ten years of analysis work. We never did, finally, get all that data transcribed.

Well, that program lasted for about four years.

Dickman: That ran nearly to wartime, then, didn't it?

Lorenzen: Nineteen thirty-seven until 1941 or 1942, yes. Yes, because one of the last trips I made to Riverside was after Pearl Harbor. We used to go down to Riverside on the train. We'd get on the train at Davis and travel overnight. I think it was the "Owl" or "West Coast," and you'd get into Los Angeles about eight the next morning. Then you'd go out to Riverside by bus or by electric train.

Teaching

Lorenzen: Well, after the war started, several people went into the war effort and the campus became a home base for a Signal Corps unit. When the war was over, the students came back and I got my first experience in teaching, because there was an influx of students and they were short on teachers. In fact, they were very short on teachers. I got associated with some of the regular teachers--Ben Moses and Professor [Russell L.] Perry, and others, and Roy Bainer of course--and started teaching in the area of graphics, drawing and also in thermodynamics and internal combustion engines.

Onion Harvester and Apricot Cutter

Then, in 1945 or '46, somewhere in there, we started work on an onion harvester. There was an onion dehydration plant in Vacaville and some of the people in vegetable crops and other departments in the University had liaison with this activity group (mostly in the area of onion quality and varieties for drying). They were interested in saving labor and we built an onion harvester which was designed to pull the onions up by their tops rather than by using the old method of machine digging, root system hand pulling, and windrowing.

Dickman: Where were these onion fields located?

Lorenzen: They were all over the state. Some of them were in Tule Lake, some of them were in Los Angeles, and there were a lot in between. But principally there were areas up north, in Tule Lake, and around Dixon and Vacaville, and then there was an area down around Los Angeles. And, you know, when we first started working on the orchard heater program, there were lots of small truck farms right in through the Los Angeles area. Eventually they were all replaced by subdivisions (laughter).

Anyway, we thought that we could pull these onions up by the tops and cut the tops off right then, instead of having to let them dry in the sun for four or five days. We could save labor that way. Well, the onion harvester was never accepted by the growers, but up in Corvalis, at Oregon State University, a fellow up there (one of our former students, Myron Cropsey) was interested in machine harvesting of gladiolus bulbs. As a result of his interest, we took our onion harvester up there one year and tried it out on gladiolus. Of course, the onion harvester was too small a device--it wasn't husky enough to handle the heavier gladiolus plant. But the idea was all right, and eventually they built gladiolus harvesters modeled after this onion harvester.

Lorenzen: That was the only contribution that the onion harvester made to agricultural mechanization.

Dickman: If the gladiolus growers accepted the harvester, why didn't the onion people?

Lorenzen: Well, many of them thought that energy went from the onion top down into the bulb and that you had to allow these onions to lie in the windrow and cure before topping them. The idea of cutting the tops off at the time of digging and letting them dry in containers in the field was not acceptable.

The next thing that I got involved in was the design of an apricot cutter for dry yards, working with Lloyd Lamoria, who, incidentally, is now the chairman of the agricultural engineering department at Cal Poly. And, again, that was a machine which did a job but wasn't accepted by the apricot industry. The growers were willing to accept it, but it never was developed by a manufacturer.

The Engineer and Plant Breeder Team Up

About the time that we were involved in that I met Jack [Gordie C.] Hanna. I knew Jack Hanna before that, but in 1949 he came over to see Roy [Bainer] and suggested that he might do some work on mechanically harvesting tomatoes. I don't know why Roy picked me out for that job, and I never did ask him. Anyway, Roy called me in the office and Jack was there, and that was the start of a quite interesting research project--at least for me. And for Jack too, I think. And, if we've made a contribution to the whole area of research, it was in the fact that we, I guess, were the first to bring together two different disciplines on a single project with a single goal.

Dickman: It's been done since, but that was the first time as far as I know.

Lorenzen: The first time. So if Jack and I have any claim to fame, it would be that small contribution.

Well, I didn't know anything about tomatoes, of course, and I was still working on the apricot machine, so the first year or two I talked with Jack on several occasions when I wasn't teaching or working on the apricot machine. I tried to learn something about the nature of tomatoes and the practice that was then used in tomato production.

At that time Jack was working on a breeding program. I think the first thing that we did together--some of these things might not be exactly the way Jack remembers them--but as I remember, the

Lorenzen: first thing that we did was to sit down and try to agree on what the major objectives of this program might be. And it's interesting that we had enough foresight, or we were clever enough--and it's probably that we were just lucky--to work out a system that eventually proved successful. I mean, we decided that there would be several things that the machine would have to do, and there would be several things that the plant would have to do. And to this end we decided fairly early in the game that we would have to have a system that would be a once-through operation, that we would not be able to build a device that would come along and find a ripe tomato on a vine and leave the vine and pick the tomato. That seemed the wrong way to try to go.

We would have four principal requirements for the tomato and the tomato vine: one, a uniform fruit set; two, that it be on a relatively small vine so that there would be more of a tendency for the fruit to ripen all at the same time; three, that the fruit would come off the vine fairly readily; and four, that the fruit would stand a little more abuse than it was getting from handpickers.

Well, it was also decided that we would not try to build a complete machine and then modify it. Rather, we would divide the machine operations up into several functions: one, a system for cutting the roots of the vine; two, a system for elevating the vine into the machine; three, a system for separating the fruit from the vine; four, a system for getting rid of the vine; and five, a system for segregating or sorting the fruit so that the culls would be discarded. The last function would be generally handling the fruit in the machine. At that time we did not think about going any farther than carrying the fruit through the machine. There was no allowance for getting the fruit out of the field. That fortuitously came along by itself later.

Well, I guess the first activity that I had in the field was to go out and dig up some vines and take a look at the structure of the vine--its root system and the distribution of the fruit on the vine. I wanted to get an idea of how much force was involved in taking the fruit off the vine, and get some measurements of factors that might help in deciding which way to go in eventually building a harvester. I remember building a little spring-loaded lever arm device that could be used to measure the force necessary to pull the fruit off the vine. It was possible to pull on the stem while holding the fruit with this little device and measure the separation force.

Dickman: Did you try a potato digger at first to see how it worked?

Lorenzen: We did--or rather, that was the first thing that Jack did. You could really say that, that was the first tomato harvester because it did pick up the tomatoes. Of course, the potato digger was

Lorenzen: simply a chain conveyor that lifted, and sorted, and in a crude way, shook the dirt out of the plant and the potatoes and then dropped everything back on the ground. Then you went throught the field dragging a sack between your legs and picked up the potatoes. The potato digger wasn't a complete harvesting machine, but it had a blade in the front for cutting the plant roots and it had a conveyor. It really could be described as the first tomato harvester.

I can't remember all the different things we did in the laboratory and in the field. I can't remember them in correct chronological order. And, especially in the early years, I had some other jobs to do and didn't put full time on this particular project.

I do remember that we looked into as many different types of systems as we could think of in order to try to completely survey all the possibilities. I think this was important because throughout the years there were several times when we were making very slow progress. It was important that the mechanical program reflect the progress in the breeding program. It was important, also, that the breeding program be somewhat--I wouldn't say controlled but--influenced by the progress we were making with the machine elements.

Jack and I each would tell people that our part of the program was going fine but the other part wasn't going so well. I would always say that if Jack would only get busy and build a tomato that we could harvest, then my part would work all right. Jack would have the same appraisal of his part. Anyway, in 1952, after about three years, we tried out a system which eventually we went back to in 1958 and used as the fundamental separation unit. But early in the game we worked on several types of blades for cutting the root system. We found that the simplest--a single blade set at about a seven degree angle with the ground in order to hold it in the ground and operating at an inch or an inch and a half below the ground surface--was the most effective.

Now, as the plant grows from a seed, the root system spreads out about two inches below the ground surface, and then the principal stem grows up from the crown and branches out, develops leaves, blossoms, and fruit sets and ripens. At maturity, this main stem above the ground becomes quite woody and tough and it's a real hard job to try to cut the root system above the ground. Some investigators were doing this with a sickle blade or rotating discs. But there's enough moisture in the principal stem of the tomato plant below the ground so that if you run a blade just above the root system, but below the surface of the ground, you can cut above the root system and sever the main branch. This was a very important factor, I thought, in our system because it made that part of the operation fairly simple.

Lorenzen: The next objective was to devise a system for lifting the vine and fruit without losing the fruit.

Incidentally, other investigators soon were working on tomato harvesters. Not as early as 1949 or '50 when we first started but by 1952, or 1953, or 1954. There were some people who had come to visit us from Purdue, and some people from Michigan State, and, I think, there was a group at Cornell, too, working on the idea of mechanical harvesting.

Dickman: Were their motives for developing the machine about the same as yours? Did they have growers pushing them or was it just an academic venture?

Lorenzen: No, I think it was an academic venture except that Michigan State was interested because they did grow some tomatoes commercially in Michigan. There was a fellow, a plant physiologist by the name of [Stanley K.] Ries, and an engineer, who worked together on an experimental field machine. And at one time there was a company in Chicago that built a prototype from the results of the program at Michigan State. After a few years it discontinued the work. I think one reason was that the Michigan area wasn't that great a tomato growing area and, at the same time, the development out here in California was so rapid that production increased here and decreased back there.

Purdue was interested in it because some plant breeders at Purdue had developed a small tomato vine. (This was the first time I really knew that the tomato was of the same family as the potato. I think Jack told me about that. One of those many little bits of information.) This Purdue plant grew straight up; it didn't fall over as a larger tomato plant does. It had only about four or five fruits on it. The idea was to plant an immensely large number of small plants per acre and get the production up that way. A fellow by the name of [Bruce] Liljedahl--one of the fellows I knew in ag-engineering at Purdue--came out to see what we were doing and to start a program in the laboratory back there working on some machine elements. I think that they dropped that after two or three years.

Anyway, instead of trying to pick up every tomato from the tomato row and see how much dirt that you'd have to take into the machine in order to pick up all the fruit, we thought that a better way was to see how much fruit you could take into the machine without taking any dirt.

Dickman: I'm not clear on one thing. You're taking the whole plant into the machine?

Lorenzen: The whole plant. Now, just the operation of cutting the vine might shake some fruit off. And in some of these varieties, where

Lorenzen: the fruit is very loosely connected to the stem, there might be some fruit which has dropped off the vine, that some investigators didn't want to leave. This brings up an interesting point which I've repeated time and again.

I suppose Jack mentioned the method of picking fruit in those days. I asked him early in the game how much of the fruit that's in the field to begin with would end up in the box in handpicking. We went out in the field and looked at the hand operation because, though I knew what a tomato was, I had never been that interested in them.

Dickman: You went to see how much fruit was being left behind?

Lorenzen: What they did at that time is this: the grower would contract with the cannery to grow a certain tonnage of tomatoes. A cannery field man would keep in touch with the grower, tell him when they were ready to harvest the fruit and when they needed it. The grower then would get his harvesting crew together.

When they first started through the field, there was only part of the crop which was ripe. Mostly it was in the center of the vine and covered by what Jack calls the canopy of the vine--the leaves which protected it from sunburn. The picker would have to look into each vine and find that fruit. And he might have to drag his box fifteen or twenty feet along the row before he would fill it. And, in doing so, he'd disturb these vines. He couldn't help but do some damage just going through the field. Then, three or four days later, whenever the next picking was, more of the fruit had become ripe. This was approaching the high production of the vines. Now, the picker would not have to go as far to fill his box. He might get a whole boxful out of just three or four feet of row. However, he would still do some more damage.

In the early days, the pickers might go into the field three, four, or five times as the fruit ripened during the season. Well, at the end of the season, there would be some fruit left on the vine which didn't pay the grower to pick. If you start at the beginning of the season and add up all these losses during the year, it would amount to about 24 percent.

Dickman: That never got harvested or never got into the box?

Lorenzen: Even on a perfect harvesting operation, that percentage never got into the box. So it was determined that 76 percent was about the maximum that you got through handpicking. The 24 percent loss was distributed throughout the season and the grower never worried about that.

But the first time we took a machine into the field and picked 80 percent of the fruit and left the other 20 percent out there

Lorenzen: in the field, the grower threw up his hands and said, "I can't stand that loss." This was amazing. So the thing that you had to do was to show the grower that (laughter) he should take just what he could get and not dwell on the losses. And furthermore, show that it was an economically feasible operation.

To get back to the elements of the machine: one time we had a device that we thought was just the best thing in the world to lift the vines and fruits. It had fingers mounted on chains that would feed in from each side of the vine. These fingers had a backward component of motion as the machine went forward. Therefore, it didn't disturb the vine at all. It just cradled the vine and lifted it upward and backward. We could pick up 100 percent of the vines and 100 percent of the fruit as long as it just didn't drop off because of its own weight. But we couldn't get the vine off the back end of the device after it had been lifted and moved to the rear of this elevator. We couldn't reverse this operation practically. We had vines swinging out and being torn apart, and we finally had to give up on this system even though I thought that we had the whole answer to the elevation part of the machine right there.

I think that over the years from 1950 until 1958, we must have investigated thirty or forty different systems or combinations of systems. During this time we would attend meetings of the California Tomato Growers' Association, and other meetings such as Tomato Day on the Davis campus. The programs always had a little space for a Hanna-Lorenzen combination progress report on the tomato harvester. This was sort of a favor to us because they really didn't think in terms of needing a machine to harvest tomatoes during the early years. The Mexican national program was in existence and it was a very successful program.

Dickman: Was this the bracero program?

Lorenzen: These were braceros. They had labor managers and labor camps, and the Mexicans would come from Mexico each harvest season; many of them, I think, would come back to the same camp and the same growers each year. They did a good job. They never presented any social problem to the community, they had their own activities in their labor camps. Some of these camps, I guess, left something to be desired, but many of them that I visited were model camps. They had their own cooks and mess hall, their own chapel and most everything they needed. The program, I think, was generally successful. But somewhere along the line Congress decided that they were going to...

Dickman: Phase it out?

Lorenzen: Yes, and I think they didn't phase it out; they lopped it off. If they had phased it out over a period of five or six years or

Lorenzen: so, I believe it would have been a better plan.

But each year, as I recall, the grower lobbyists would go to Washington and through their efforts they would get the program renewed for one year. Then they would come back and everything would be fine until the next crisis at the end of the year. Then finally Congress decided that this was the end and they were going to run it for one year and stop. I might be wrong about that but, as I recall, it was continued for one year. Anyway, it created a critical labor situation--the growers now needed something in a very short time.

Dickman: Within a year?

Lorenzen: In one year. And about that time we were working on a little machine that would be self-propelled in the field. A fellow by the name of Les Heringer, a grower in Holland Land [in the Clarksburg area] was very instrumental in getting this mechanical tomato program started because he not only allowed us to ruin part of his crop with our experiments, which I think is an important factor--you have to have somebody who will cooperate with you and allow you to do some experiments--but also because he was willing to help finance the commercial prototype.

Incidentally, going back a little bit--when we first started this program--we would spend a very short time in the field because most of our work was done in the shop and the laboratory trying to develop something that we thought might work. Then when we'd take it out into the field; we'd find out in a very short order that it wasn't going to work and there was no reason to continue. Jack, very early in the game--perhaps he told you about this--got the idea that he could get about two seasons' work in one by first going to Southern California. He would go to the field station at El Centro and would plant a crop of tomatoes that we could go down and work with in May or June. We'd run some experiments down there and we'd find something that worked or didn't work and then we'd come back, do additional lab work, and be ready for the field trials in September up in Davis.

Dickman: Jack said, incidentally, that it was during these trips with you--when the two of you could pick each other's brains without any interruption--that he got more understanding of what your problems were, and he thinks you learned more about what his were, than at any other time.

Lorenzen: Yes, that's right. I also got sick every time I went down there. I don't know whether he mentioned that.

Dickman: On account of the heat?

Lorenzen: (Laughter) yes, until he got the idea of taking some Davis water

Lorenzen: in a big milk can (one of these old-fashioned milk cans). After that we were okay.

Eventually Jack went farther south--down into Mexico--and he would make plantings, get seed, and then come up here. This saved some development time.

In the meantime, Jack had begun to develop some varieties that really showed promise of success in yield and in the other important factors. I really had an education--when you talk about the work that Jack did--in all the different physiological factors that are involved in a product like a tomato. When you "mess around" with one and get something you want and something else you don't want--maybe the color might be good, but it doesn't taste any good or the solids aren't any good or you can't get it off the vine with a ten-ton truck, or something like that--you'd have to throw it out. I remember one time when Jack developed a small vine which we thought was ideal for our purpose. But out in the field the leaves wouldn't stay on the vine. All the energy went into the fruit, I guess, instead of the leaves, and the fruit would get sunburned. So Jack decided that he'd have to back up a little ways and get a little larger vine with better characteristics. He began to develop some varieties which were very well adapted to mechanical harvesting. At first we thought we were going to be involved in the pear-shaped tomato, which was by its nature, generally more readily mechanically harvested: it was a tougher type. But along the line Jack got the idea that he could make the round tomato respond to his magic touch and, as I say, he got these other varieties going, and they were the ones that really made the machine a success.

There's no doubt that the development of the tomato was the more important part of this program, because there are so many more factors involved in getting a tomato that would stand up under mechanical abuse and, for example, come out as a tomato, not as just juice; have a good cannery yield; in a word, be a product that was commercially practical.

In 1958, we took the first prototype into the field at Les Heringer's ranch to demonstrate to the growers what could be done. That's when they were quite alarmed at all the loss of fruit in the field. Incidentally, in that regard I think it was the following year that Heringer distributed bins around the field with the idea that he would get workers to come along, pick up the good fruit that was left by the machine, and drop it into these bins. We very soon found out that he couldn't afford it; couldn't afford to do it. That was one of the clinchers of the program; the idea was to take the percentage of fruit that you got the first time through and not worry about what was left on the ground. As a result of having this little machine in his field in 1958, Les Heringer went to Blackwelder Manufacturing [Company] in Rio Vista.

Lorenzen: (We didn't have people knocking at our door wanting to manufacture this machine, incidentally, so it was fortunate that Les Heringer was able to help support this program and Blackwelder was willing to take a chance on it and to develop this first prototype.)

Well, the first year they manufactured the machine they spent most of the time modifying it. At the end of that year they figured that they had a machine that might be commercially practical. But in order to get started we had a meeting and we decided how many machines we would build. I wanted to build ten. It ran all the way from two or three up to fifty, and they compromised, I guess, on twenty-five. So Blackwelder built twenty-five machines. They had twenty-five machines purchased before they built them because that was the way they started this operation. I remember that Llewelyn Brown, who was manager of the Tillie Lewis cannery in Stockton--had a young field man [Robert Hartzell] who was very much sold on this machine. He convinced the cannery to buy one of these machines. The rest of the machines were owned by growers.

Dickman: How much did they sell for?

Lorenzen: I think it was eighteen thousand, five hundred dollars, something like that. Jack would remember better than I would, I think.

The First Year of Mechanical Harvesting

The first commercial year, after the twenty-five machines were built and sold, Blackwelder was interested in keeping these machines in operating condition and servicing them. He purchased several pick-up trucks, manned them with welders and equipped them with tools for servicing, and they were out in the field, going from one machine to another. As I remember, out of twenty-five machines, about seven machines kept going that first season. The others encountered various troubles such as a muddy condition and the growers would go back to hand harvesting. It was a rough season, rough period. But I remember the Hatanaka brothers in Woodland. They kept their machine going all season, and they showed that they could harvest the tomatoes for a little over half of what it cost them to harvest by hand. I think this was the one example, the one bright ray of hope in the cloudy sky, you know, that made the thing go.

Dickman: Do you remember when that was?

Lorenzen: Well, I think it was '58 when we had the little machine, '59 when we built a prototype, and '60 when we first got one out in the field--or I'm a year off, and it was '61. It was either '60 or '61.

Lorenzen: One of the things that we did that first year was to take some of the fruit that we had harvested from Les Heringer's ranch, truck it to Stockton, and put it through into the cannery there. And, I remember that when we dumped the mechanically harvested fruit onto the input line at the cannery (laughter), and waited for this fruit to come along on the inspection lines, that there was just a bunch of cores there on the line and about eight inches of juice in the bottom of the bin (laughter). By the time this fruit had gone through the washer, the hot water washer, and the cold water, and whatever else it goes through, there was practically nothing left (laughter). It left something to be desired, to say the least. But at least it was a start. That was an interesting experience, when you look back on it. But it wasn't so funny at the time.

When we developed the machine, we hadn't thought very much in terms of handling of this fruit, but we had designed the machine to handle ten tons an hour, which we thought was a reasonable harvest rate. But when you talk in terms of an average size fruit, that means that you would have to fill a field box with fifty pounds of fruit every three seconds. Well, when we actually woke up to this, we knew that we couldn't very well have the machine handle boxes. It just happened at that time that Mike [Michael] O'Brien* was working in peaches. He was working in deciduous fruits, handling agricultural products in bins rather than boxes. His principal reason for doing this was to save space in the warehouse, and fruit in many small containers takes up a lot more space than fruit in larger containers. Well, after he saw these boxes stacked up here we decided to adapt the bin to the harvester.

At one time we thought about carrying five or six empty bins on the machine, loading one and dropping if off on the ground, and loading another and dropping it on the ground, so that by the time you got down a two or three-hundred-foot row you had distributed these bins along the row. Then you went and picked up more empty bins. But in looking at the problems of handling and carrying these things we finally evolved the system of carrying empty bins on a trailer alongside the machine and having, say, a complement of three tractor-trailer units per machine. One unit would be moving along with the machine, one unloading over at the staging area, and the third one getting ready to come in under the machine when the first group of bins was filled.

Dickman: How many boxes could you get into a bin?

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*Professor of Agricultural Engineering, University of California, Davis.

Lorenzen: Well, a bin holds about eight hundred pounds, so that would be about sixteen to eighteen boxes.

Dickman: Were you able to hit your ten tons an hour that way?

Lorenzen: Oh, yes, we were able to hit ten tons an hour. In fact, nowadays they harvest about three or four times that. They have speeded up the operation. I think they've gone up to forty tons an hour. But a lot of that now is due to the continuing development and perfection of the fruit and the vine.

The machine had to have a sorting system. We knew very early in the game that we would have to remove what dirt we took in with the fruit and that we would have to get rid of the culls--the damaged or the dirty or the unripe fruit. The place to do that was right in the field. So there were inspection belts that would carry the fruit in front of sorters who rode on the machine, and the sorters would pick out the culls and drop them into a little slot right in front of them to lay them back down on the ground. Well, during the early years of the machine, when we had a commercial operation going, the idea was to train sorters so that they would pick the poor fruit and the dirt out of the mass of fruit coming along the belt.

Well, it would be ideal if you had five sorters on each side of the machine and each one would pick out 20 percent of the culls and the dirt. Each one would be doing about the same amount of work. But in practice the first picker in line would see more fruit and more dirt, and he'd be doing more work. Maybe the last one down the line, just before the fruit went into the loading conveyor, wouldn't have too much to do. Also, the field would not be uniform, so as you went through it at one time you might be getting more fruit per foot of travel of the machine than at other times. Sometimes you'd be getting into a heavy producing part of the field. Some areas of the field would have more green fruit than ripe fruit. Also, as you went through the gear, early in the season you'd have more green fruit because it hadn't matured yet, and later in the season most of the fruit would be ripe. These different factors would change the amount of work the sorters would be doing on the machine.

Sometime quite early in the game we found that--if they happened to be going along at a pretty good rate, and if they were in a good production area of the field, and if most of the fruit was ripe, and if there was not too much dirt--perhaps the first two or three pickers would handle most of the sorting load. But the last two pickers would still think they'd have to be picking something and they'd be throwing out good fruit. Someone--and I don't know to this day who it was--got the idea of putting an extra man on the machine to act as a supervisor, to oversee the sorters. He more than paid his way because he could tell them to do this or not, and he could see the product coming off the end of the line and tell whether it needed a little more sorting,

Close-up of the sorting on machine operation

Lorenzen: or a little less, or to lay off; and that was, I think, a very important development. I don't know who did that first, but whoever did it did a good deed, and later machines had a separate station built for the supervisor. Nowadays he is sort of the controlling factor.

The first year, as I said, we had only about seven machines that stayed in operation out of the twenty-five, but there were enough results to give us an idea what could be done. With the help of Mike O'Brien and some graduate students during that first year, we went out in the field and took samples by holding canvasses under different parts of the machine in operation. We collected samples of the product that was being lifted off the ground, of the product that was being discharged from the top of the elevator, and of the product that was coming off the back end of the machine--that is, the amount of fruit that hadn't come off the vine or hadn't been shaken off the vine. Also, we noted the amount of dirt that was picked up, the amount of product that was being thrown back by the sorters, the amount that was being carried along the sorting belt, and the product that was going into the bins. By analyzing these different samples we could determine where the problem points in the machine were. And by giving that information to the manufacturer and discussing the changes, he was able to improve the machine each year. And after about the third or fourth year most of the "bugs" had been taken out of the machine, and it was an established fact that it could do a good job for you.

Dickman: How did you eliminate the problem of ketchup in the cannery?

Lorenzen: (Laughter) well, that first year, of course, was just to see what kind of a product we could get into the cannery. Jack Hanna will be the one to comment on that; he was changing the variety that we were growing each year. One reason that we had such a poor product that first year was that if you take a tomato and carry it along in only one direction it will hold up pretty well. But if you bounce it and drop it and roll it and slow it up and speed it up and change its direction, you soften it to such an extent that when you start to process it, it falls apart.

The first machine had quite a short, steep conveyor and it dropped the vine onto the separating bars or the separating unit which was quite a bit lower at the front end than at the rear end. This shaking and transporting operation of the separation unit shook the fruit and lifted the vine upward and backward. Right under this separation unit was an inclined belt, the surface of which was driven upward and backward. It was inclined at such an angle that the fruit that was dropping on it would roll forward against the action of the belt, but the dirt and the debris and the leaves would carry up and drop off the rear end. That was a natural type of separation unit and a very effective one. It's

Lorenzen: been used in other systems, too. The trouble was that in order to get the fruit from the place that it dropped off the separation unit down to the front of the conveyor, it had to roll. It wasn't just like rolling a little distance; if the belt had been five feet long and stationary, the fruit would have to roll only five feet. But if the belt is going backwards the rolling fruit actually goes twenty feet. So the fruit coming off the machine had been banged and rolled and had changed direction several times, so that it was quite soft.

At the end of the first season that system was changed, and a different conveying system was used. Instead of bringing the separated fruit forward, now it was brought to the back of the machine, which was just its natural travel anyway. It was fed very gently off one conveyor onto another instead of dropping. This, then, resulted in a much firmer fruit coming off the conveyor and into the bin.

We found that even if we had a good product coming off the machine, if we elevated the loading conveyor and dropped the fruit five feet into the bin, that last drop didn't do it any particular good. So we developed a system for slowing down the fruit as it went into the bin. By minimizing this last drop we were able to get a much better product into the cannery.

Dickman: At that time, the first two years, were you using the pear-shaped fruit?

Lorenzen: We started out with the pear-shaped fruit first, but the second year we were using one of Jack Hanna's round varieties. It wasn't exactly round, but a round variety. It was smaller and firmer than the handpicked variety.

Competition Between the Manufacturers

In the meantime, several other manufacturers were developing machines. FMC [Food Machines Corporation] was building a machine. I remember one amusing incident. I don't know whether I should put this on a recording or not, but FMC was never bashful about looking at other people's products. I remember one time Blackwelder had a machine out in the field. We were doing some work on it and we all went to lunch. When we came back, there was a car out in the field by the machine. We walked over and there were two or three engineers from FMC; they were climbing all over the machine and taking measurements. I remember the comment of the chief engineer of Blackwelder. He said, "Just wait 'til I get back to the office and I'll send you a set of blueprints (laughter)."

Anyway, there were three or four separate manufacturers of

EARLY DAYS - NO SHADE

Lorenzen: machines, and the growers preferred certain features of one machine over another as time went on; but, as I remember, that Blackwelder machine accounted for about 50 percent of the total used in the field in any one season. I think gradually the total got up to about fourteen hundred machines.

I saw Blackwelder last year. Ernie Blackwelder is now semi-retired; his son and nephew are running the business. They are involved in other activities beside the tomato harvester, but they are still perfecting the machine here and there, and they still have a production line. I suppose that the price of machines has gone up.

Sorting and Sampling

Another thing: you ought to get Mike O'Brien's comments on the sampling, because he was instrumental in developing the sampling system for tomatoes. When tomatoes were picked by hand, they were put in a fifty-pound field lug box. The operation, of course, involved loading the boxes in the field and then going to a state inspection station for grading before going to the cannery. In the days of hand harvesting, these state inspection stations were distributed at various places around the state, maybe next to a cannery, maybe not. The truckload would be driven to the inspection station and the inspector would mark certain boxes at random. It might be two rows over and three rows in and four boxes down, and the driver would have to fish that box out. They'd take three boxes out of each truck or trailer load, and the whole load would be accepted or rejected on the basis of this sampling. They would sample for worms, dirt, cuts, undercolor, and mold. Mold builds up quite rapidly in fruit that's standing around. With the abuse that the fruit got in the mechanical harvester, mold was a problem to begin with. But, with a bin holding eight hundred pounds, it's hard to get a sample. You can't use one bin as a sample. You've got to use part of a bin--maybe parts of two or three different bins. Mike developed a system of dunking the fruit in a water bin to permit a cylinder to be lowered through the fruit in order to collect a sample.

Another thing worth mentioning is that somewhere along the line they got the idea that they ought to sort these fruits automatically, instead of having sorters on the machine. Blackwelder did some work with a company in Texas on electronic sorting of fruit. He did some very excellent pioneer work, but it hasn't been accepted.

Dickman: On the basis of light content color? Like the lemon sorter?

Lorenzen: Yes, like the lemon sorter.

Lorenzen: A big factor in tomato production, which does affect the machine but was not a machine development itself, was the so-called central sorting system where, instead of having sorters on the machine, you'd just run the machine through the field and pick up everything that the machine took--no sorting at all--into the bin, and then carry the bin to a central sorting unit. You might transport this fruit half a mile or as much as seven miles from the field. This central sorting took the sorters off the machine and put them on a stationary spot, rather than on a platform moving around the field, and it probably used a different type of person doing the sorting. Also, if the machine load came in and the fruit was underripe or had too much dirt or was rejected or something of the sort, then some of these central sorting stations would accept this fruit, run it through their central sort, put it back on the truck, send it to the cannery and recover the good part of the load that had been rejected. Generally, in the old days, if a load was rejected, it was taken down behind the barn and dumped; and it was all gone. So, the central sorting did--I guess it still does--perform a function.

Dickman: Thank you very much.

ERNEST BLACKWELDER

University of California Invites Manufacturers to Consider Securing a License

Dickman: Mr. Blackwelder, when did you first consider manufacturing the mechanical tomato harvester, and what was the background of that decision?

Blackwelder: Ralph Parks of the USDA [United States Department of Agriculture] called us to attend a meeting in Walker Hall [at UC Davis] in 1959. We were included with seven other firms, including one major one. Dean [Roy] Bainer and Professors Jim Fairbanks, [Coby] Lorenzen and [Gordie C. "Jack"] Hanna were in attendance along with others at the University. The group of us representing the equipment industry was there to consider whether any of us would be interested in building a tomato harvester under the design of the University of California at Davis. We were told that patent application had been made and if we were interested a license could and would be negotiated at that time, possibly on an exclusive basis.

Dickman: At that meeting, did the University show you the kind of machine that they had developed?

Blackwelder: Yes; the experimental machine that Coby and his group developed was experimentally tried on the Heringer ranch prior to the invitation to the meeting. And we were able to see that machine on the campus at that time. They presented to us the background of the engineering work that had been completed and the patents that were to be applied for.

Dickman: What was the effectiveness of that machine?

Blackwelder: It was truly an experimental machine, and it would only run a short distance at a time. It was mostly hand operated, and was

Blackwelder: pulled by a tractor. It was very crude, as are most experimental machines. Coby and his associates were merely trying to prove their theory of picking up tomatoes and separating them from the vines. That was the entire extent of the machine. All the other parts of the materials handling and the self-propelling were later developments.

Dickman: And then what happened?

Blackwelder Meeting With University People

Blackwelder: Well, Fred Hill, our chief engineer, Bert, my son, who is now president of the company, and myself were in attendance to consider the proposal.

On the way home the three of us discussed the proposal and thought we would like to consider seeking a license, providing we could find some principal grower who would be interested in sharing the cost of development of the first machine with us. I don't remember whether we contacted Les Heringer, or he contacted us, but we eventually developed a program with him. Heringer agreed to share half the manufacturing costs, which would include labor and materials only. We agreed that when the unit was completed and tried on the Heringer ranch, if they wanted it, the machine would be theirs. We would reserve for ourself and the University any improvements or developments that were patentable. Les agreed and we started work in 1960.

After we decided that we would like to be licensed I contacted Dean Bainer, I think he was chairman of the department of ag engineering at that time, located in the Walker building, and told him that we would like to meet with the proper University folks and consider a license. He suggested that the best thing would be for him to meet me in Bob [Robert M.] Underhill's office. Bob was treasurer of the University, and secretary to the Board of Regents, and in charge of their patent program. So Roy met me there and took me in personally and introduced me to Bob Underhill. We negotiated for a patent at that and other meetings that Underhill and I had. We insisted that the license be exclusive at the time because we had had experience in taking an idea and developing it into a commercial product and we knew to develop it would cost well into six figures. We weren't interested in doing it unless we would have some protection.

Blackwelder: With this licensing assurance and the assurance of Les Heringer, we gave the project to our chief engineer, Fred Hill. Loren Gates was put in charge as a project engineer and we started the work on the first machine. (By the way, two or three years ago we repurchased this original machine that we built, and we have it on the property and we've offered it to the University when they get their machinery museum set up. This machine will then be given back to the University for the museum.)

I'd like to mention just a bit more on this patent deal. There's been so much said whether the University should patent a development and give an exclusive license. To me, there have been so many projects started and not patented which are still on the shelf because nobody has an interest in them. So to make the work effective it has to be put into a commercial enterprise. Regardless of who is going to develop the idea, they will not do so unless they have some protection. And, I think this is one of the principles that has to be recognized. The University over the years has received substantial royalties; it's been more than justified from the end results, because the tomato crop has meant a great deal to our California economy. Not only to the growers and processors, but to the economy of the entire state, particularly from the agricultural point of view.

Dickman: This machine is called the University of California-Blackwelder Tomato Harvester, is it not?

Blackwelder: That's an interesting question. When we had been licensed by the Regents to build the harvester, and we were given an exclusive license for five years, which has had renewals now, we asked the University Board of Regents, I think through Dean Bainer and Bob Underhill, if they wouldn't permit us to put the "UC" in front of Blackwelder and call it UC-Blackwelder. After considerable consideration, they wrote us a letter, a formal license to use "UC" in front of our name, and we are told that it's one of the first times, if not the first, that the University has permitted such a use of their name on a commercial product. A very nice letter was written explaining to us why they permitted us to use the name. And we still have that privilege; it hasn't been withdrawn. We feel very proud that the University has granted us that right.

Manufacturing Problems

Dickman: What marketability did you estimate this machine might have at

Dickman: that time?

Blackwelder: All that we knew is what we were told by the University people. We assumed from their figures that it could be rather extensive. About 65 percent of the processed tomatoes in the United States were grown in California, and we were losing this acreage quite rapidly due to the fact that the bracero program was going to be discontinued and there would not be labor to hand harvest the crop.

Dickman: Was that known at that time, in 1959?

Blackwelder: Yes, it was coming out at that time. The bracero program was still in effect, but it was public information that at a given time the government would discontinue the bracero program. It was just so fortunate that ten years prior, Coby Lorenzen started in on the machine with his group of people and Jack Hanna started on the tomato variety at about the same time, so they came together almost simultaneously. So we could see, after talking with some of the processors and some of the major growers in California, that there was a definite need for a mechanical tomato harvester. And if we just built enough for California, it would be a substantial production at the outset.

But when we saw it demonstrated at the Heringer ranch in 1959, we knew that there was a great deal more to be done. That experimental model left a lot to be desired, both from the [point of view of] fruit and the machine. The fruit wasn't the type or variety that we know now--the VF 145. Hanna had made great progress, but he also recognized the fact that he had further work to do [on the tomato] and we had further work to do on the machine, and we had to learn that from the time that you prepare the soil until the product is delivered at the cannery, the whole program has to be under one system.

Dickman: What was the fruit used at the Heringer ranch? Was that the Red Top?

Blackwelder: Yes, that was the Red Top, or pear-shaped tomato. It came off the vine quite easily, and it would withstand the shock load that we were putting into the tomato for separating. Whereas the round or the Beefsteak tomato that we knew at that time would not stand that type of handling but the pear-shaped or Red Top was able to. And we were able to do a reasonably satisfactory job with that variety. We tried some of the bigger tomatoes later on that year, but the results weren't very satisfactory. They splashed when they dropped into the bins.

Dickman: You had ketchup?

Blackwelder: Yes, before we were ready for it.

So out of these early experimental trials we learned that the processors were willing to go along with this program as well as some of the large growers. Two of the processors, the Heinz company under Willis Moore's recommendations, and Tillie Lewis under Llewellyn Brown both bought machines. Bob [Robert] Hartzell was Llewellyn's assistant at that time, and Bob worked very closely with us, as did Willis and his people in the agricultural department at Heinz. Both purchased a substantial number of machines. They gave us a good down payment, which helped us finance the development of the machines, and the backing that we needed at that time. As a result of that we were able to get banking support for a large program.

Dickman: How much capital did you have to risk to build the first model?

Blackwelder: Well, by the time that we had built the first one of the twenty-five and did the updating on it, we had over a quarter of a million dollars in the program. This was before we were really ready for large production, and before it returned anything to us. We had quite an investment in it. We used the down payment on the machines that were ordered, the bank went along with us and financed us, and we used our own funds. We have now built over eight hundred machines and have them scattered throughout the United States and about nine other countries.

Dickman: Were there bugs in that first model?

Blackwelder: Well, we had some functional bugs. That is, we were leaving some tomatoes in the recovery of the full crop.

Dickman: What percentage were you leaving?

Blackwelder: Oh, it looked pretty red, but if we actually got down to the percentage, I presume it was 10 to 15 percent, which is too much; this wouldn't be tolerated today. And then we had damage to the fruit. We didn't prepare for the flow through the machine like we did later, when we developed a new material handling system. We were dropping the fruit too far and some of the bruises didn't show up until after the fruit was delivered at the processors, and some of it was stored twenty-four days before processing.

And then there were naturally some mechanical problems like the type of a knife used to sever the root, and the flow of

Blackwelder: the vines and the fruit up the elevator to the separating unit, and then the width of the space between the cleats on the separating unit--we lost some small fruit, so that had to be changed. And then, on the rear end, our transfer from the collecting conveyor to the side-sorting elevator, gave us some problems.

We were dropping the tomatoes too far from the elevator into the bins that were being pulled alongside on trailers. We had to put a retarding drop chute that absorbed the energy that was in the fruit on its fall, so that fruit didn't splash and we'd have ketchup before it was delivered. And there were some other mechanical things that we had to learn and overcome. For instance, we didn't realize that the acid in the tomatoes would rust the bearings and so we had to have the makers of the bearings provide some special seals against the juice around the bearings--at first the bearings wouldn't last one season. And now we feel that we should get at least three seasons' run out of the bearings. A lot of the growers go through the machine every year and look over the bearings and change them if necessary.

Dickman: How many machines were in your first production run?

Blackwelder: We built the first machine in 1959, had a short run, made modifications and had a full season in 1960.

We built twenty-five in '61. Due to mechanical problems, and the need to improve tomato varieties, and plentiful labor being available, we didn't build any more until '64.

Dickman: How did you happen to select twenty-five?

Blackwelder: Oh, it seemed to be a good number, and we were able to secure commitments for that number.

Dickman: Did it turn out to be too many?

Blackwelder: Well, it turned out to be too many because we had some problems built into them which we had to correct. You multiply the problems by the number of machines you build, and that's the number of problems you have.

Dickman: What did they sell for?

Blackwelder: We sold the first production run for $15,000 each

Grower Acceptance and Cultural Practices

Dickman: Was there any grower resistance?

Blackwelder: Oh, there were a lot of adverse comments. Some weren't ready for the machine and some felt that we were leaving too many tomatoes on the ground, and the recovery wasn't up to where it should be, and that we weren't able to handle all the varieties. It's natural. Any time you come out with something new there's always going to be some people who are not ready to accept it. Conversely, now harvesting is 100 percent mechanized in California. So they've all accepted it now, without exception.

We found that the cultural practices were almost as important as the tomato variety and machine. We all needed to know how to prepare the ground and the seedbeds, and prepare for irrigation and then how to plant, and the varieties to plant for your soil, and how to cultivate and irrigate for that soil. This was a new product and a new variety, and a new method of harvesting. There were several people that worked with us and helped us to develop the program, which was explained in a series of six educational sheets that we published. Bill Sims Ag Extension in Vegetable Crops, Mel Zobel of Ag Extension in Yolo County, and Ray King of Ag Extension in San Joaquin County, helped us with these. And every year in Rio Vista several hundred growers and processors would come to a luncheon meeting with us. The University would have Bill Sims and others come over and conduct the meeting and explain what they had learned the year before, and we kept everybody up to date. Finally, the entire process of preparing and growing and harvesting and delivery was pretty well understood throughout the industry.

And the processors had to learn how to handle the fruit through their plants. At one time we did have some mechanical designs that shouldn't be there, and these have been pretty well eliminated, but processors were very tolerant at first in accepting some of the loads that they wouldn't think of accepting today.

Dickman: Would you discuss those six sheets which you published and distributed?

Blackwelder: Well, we called them Tomato Facts [and Features], and there are six in the series.* They go from the bed preparation to the planting of the seed, preparing for irrigation, and cultivation, and maturity. Instead of waiting until you had 100 percent mature (that's one of the characteristics of the VF 145,--approaching complete maturity at one time), you should start when you have a little over 80 percent mature, and by the time you get done you'd have 100 percent and you won't lose part of the crop. If you wait until they're 100 percent mature to start harvest, some are going to be over the hill, as we call it, by the time you finish harvest.

Dickman: Now, these were printed and mailed out all in '61? All six?

Blackwelder: No, these were prepared in '66, after we'd had four or five years of learning. We held these meetings prior to this publication. Mel Zobel and Bill Sims came to most of our meetings, as did Ray King, and they would present what they had learned from the year before. Then when we finally got far enough along we developed the six Facts and printed thousands of them, and they have been sent all over the world and are used more or less as a Bible for growing processed tomatoes for mechanical harvesting.

Dickman: A set of those, I believe, is in the Archives of Special Collections of the University [of California, Davis] Library.

Blackwelder: Yes. We don't have a complete set any more, and we haven't reprinted them.

Comparing the 1974 Model to the First Machine

Dickman: As I recall, that first machine had six sorters on each side, did it not?

Blackwelder: Yes.

Dickman: Who conceived that idea?

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*"Fertilization and Weed Control," "Irrigation," "Cultivation and Thinning," "Sorting," "Harvest Timing and Management," "Seedbed Preparation and Planning for Machine Harvested Tomatoes."

Blackwelder: I would think that Fred Hill, our chief engineer, and Loren Gates, the project engineer, worked on that, on the materials handling. We still use the same system. I think it's been duplicated otherwise, more than once. But it's a very satisfactory flow. We have to get the sorters' platforms comfortable; it was necessary to reduce the amount of dust for the comfort of the people. Quite a number of women are working on the machines at this time.

Compared to our machine that we're building for 1974, there's quite a contrast. This is all hydrostatically driven now, and we have more conveniences for the sorter, and it is cleaner, and we have a soil eliminator that we didn't have before. And our recovery is way up. It's very good.

Dickman: What's the price of the new machine?

Blackwelder: The machine we're building today [1975] will sell complete for $63,650. That's due partly to inflation, but not entirely, because we have a much more sophisticated machine. It's all push button controlled, and the drives are hydraulic, with variable speed to control the conveyors, so that if you have a real heavy crop with quite a few greens, you can run slower to get the greens out. If the crop is in full maturity then you can move right along, and then towards the end of the season, if you have fruit damage due to mold and rotting, you can sort that out. So we can control the speed of all the different components in the machine. We can increase or decrease the ratio of the separating device for heavier crops, slower for more severe shaking, and this is determined somewhat by the variety of the fruit that you're handling. Some fruit handles pretty easy and won't damage, and some you can damage.

Dickman: Is the use of sorters, then, the same as it was originally?

Blackwelder: Instead of sixteen, we can put a maximum of twenty-two sorters on the machine. And that's due to the fact that we are moving much faster. Our rate of harvest is higher. One of our machines today will do two to three times what some of our original machines would do.

Dickman: Taking a thousand acres as an example, what was the rate of harvest on that first machine, and what is it now?

Blackwelder: Well, there are so many variables in a tomato field: the size of the field, the length of the rows, the condition of the beds and the condition of the fruit, the ripeness, and so on. Originally we used to say a machine, over a season, should harvest about one hundred acres. Now we're way up above that. We

Blackwelder: think we should be able to do two to three hundred acres in a season with one machine. So I feel that the present machine will do two to three times what our original machine did. Easily, comfortably. We can go into a field that's approaching full maturity and move faster than we could before; therefore we feel that we can recover more of the fruit.

Dickman: How would you contrast that with hand picking?

Blackwelder: If you're talking about recovery, when we started in '60-'61, with hand-harvested crops that would be gone over three times you'd get sixteen to seventeen tons, state average. Today our state average is twenty-one to twenty-three tons. We're going to have somewhere over 260,000 acres in California this year [1974], the state estimates, which will give somewhere around six million tons.

Dickman: What was it in 1960?

Blackwelder: Oh, I think we were somewhere around two and a half to three million tons. There was some question on the part of some critical people that the mechanical variety wasn't as good a fruit as the old handpicked variety, but I think the marketplace determines that, and they are selling more tomatoes now than they ever did. In 1968 six million tons broke the market. Now we figure it will take about six million tons to hold our own in the market. They really move fast down in the San Joaquin where they have big acreages. There's some up here, but not many.

Dickman: How much down time will they have, running that fast?

Blackwelder: Well, we have some, sure. When you get some plugging from the dew and moisture, if you don't stop to clean out, and if you go till you have to stop, you will have down time. And then you will have a mechanical problem any time you're working out in the weather and the soil, and the weed condition, and so on.

Dickman: How do they handle in wet soil and weeds, compared to ten years or more ago?

Blackwelder: One thing that they found out is, it doesn't pay. They keep the field in good shape. If you notice, the tomato fields are much cleaner now than they used to be. This is the result of improved culture practices. We can handle weeds, but you must slow down for them, and this costs you money when you have twenty-two people riding. It may cost you part of your crop, too. The farmers now growing tomatoes are pretty good farmers. The marginal people are no longer growing tomatoes.

Dickman: Well, at $63,650 each, you've got to be a pretty good farmer.

Blackwelder: They are being financed, and in three years some of the machines are paid off.

Dickman: Thank you very much.

LESTER S. HERINGER

The Labor Situation Before Mechanization

Dickman: Mr. Heringer, what was the labor situation facing the tomato grower in 1959 and 1960?

Heringer: Well, even before 1959 and 1960 we realized that the bracero program was rapidly coming to an end. Public Law 78 provided the authority under which Mexican farm workers came to California to pick tomatoes. This was known here as the bracero program and it worked very well. We growers realized as early as 1959 that this program would soon end.

The bracero program was approved every two years until 1961, when it was approved on an annual basis. Congressional representatives in Washington told growers the program would be phased out. We realized public opinion and labor would soon bring this about. With unemployment in this country in mind, we first had to hire and transport available workers in this country from the various southern states and Texas before we could bring in the braceros. After all the expense involved of hiring and transporting these U.S. workers to California we found they didn't want to work after they arrived. Many left as soon as they arrived. The program was extremely costly to producers who could ill afford this waste of money when tomato prices barely covered production and harvesting costs.

With these kinds of requirements, the federal and state governments quickly built up so many regulations and requirements that producers turned desperately toward possible mechanization of the harvest as the only reasonable solution.

Dickman: Were all of the growers at that time of the same mind, or did some of them think that it was futile to try to mechanically harvest the tomato?

Heringer: Realizing that mechanization was the only workable solution, many tomato growers, not geared to this kind of a change and with little faith in the future of the tomato business, dropped out. Many growers, and processors too, believed the industry would shift from California to Mexico, where the labor was.

Dickman: Were canneries also thinking along that line?

Heringer: Yes. There is ample evidence that processors shared the growers' view. Del Monte, Heinz, Campbell Soup Company were already in Mexico with tomato processing facilities. Others were actively surveying Mexico for the best location to establish processing facilities.

Harvesting with the Prototype Machine

Heringer: It was during this period that growers looked to the University of California breeders and engineers, and found that Jack [Gordie C.] Hanna was already working on the development of the type of plant and fruit that would lend itself to mechanical harvesting. They found Coby Lorenzen and Roy Bainer, agricultural engineers, working simultaneously on the kind of equipment that would successfully harvest the fruit. These workers had started in this direction as early as 1954. In the fall of 1959 the Heringer Ranches set aside a number of rows of pear-shaped tomatoes on which the first prototype machine worked to mechanically harvest tomatoes.

Dickman: Was it the Red Top?

Heringer: It was Red Top and it looked to me like this experimental machine had real possibilities, with further refinements. So Jack Hanna, Coby Lorenzen, myself, and the Blackwelders got together that winter and started putting together a machine for use the following season, which was 1960. We would continue our work with Red Top because we had nothing better at that time.

Harvesting with the First Commercial Machine

Heringer: So we planted and harvested twelve hundred tons of Red Top in 1960. We worked day and night. We ran the machine during the day and spent the night making adjustments to keep it running.

Dickman: Was this the same prototype machine?

1960-witnessing the operation of the revolutionary new Blackwelder-U.C. tomato harvester are(from left to right) Ernest Blackwelder, President, Blackwelder Mfg. Co., Lester Heringer, Heringer Brothers Racnches, (the ranch on which the harvester was demonstrated) Roy Bainer, Chairman, department of Agricultural Engineering, U.C.Davis, Fred Hill, Chief Engineer, Blackwelder Co., Coby Lorenzen, Agricultural Engineer. U.C.Davis

Heringer: The 1960 machine was put out by the Blackwelder Manufacturing Company. This was the first and only mechanical harvester built in 1960. In 1961 our Heringer Ranches purchased two more machines which we used to harvest the pear-shaped variety Red Top.

Following the 1964 season the bracero program came to an end. There was no choice for growers: they had to mechanize or stop growing tomatoes. It never was a matter of putting U.S. workers out of a job. They never did harvest more than a fraction of our California tomatoes.

Jack Hanna had developed, selected and released the VF 145 mechanical harvesting variety of tomatoes shortly after the 1960 season, and by 1964 this was the major mechanical harvesting variety in use in California. And so in 1965, with the braceros gone, California showed the world it was in the tomato business to stay. The varieties produced well. The machines did a good job of harvesting the tomatoes. The industry had overcome a serious threat posed by the lack of labor to pick the crop.

Dickman: Coming back to 1959-1960, did the Tomato Growers Association give financial support to the University in this project?

Heringer: Yes. In fact, before '59 and '60 the Tomato Growers Association was financing some of the research for Dr. Hanna, and also on the machine. Growers contributed approximately twenty to twenty-five thousand dollars toward this research over about a ten-year period.

Dickman: You personally gave financial support to the project, didn't you?

Heringer: Yes, we did. The financial support was in the buying or the developing of the first machine through the University and Blackwelder. We agreed to put up the money.

Dickman: And how much money did you put up?

Heringer: In 1959, Heringer Ranches put up approximately fifteen thousand dollars for the development of the first mechanical tomato harvester.

Dickman: The Heringers are a rather extensive family. How many of you are there?

Heringer: Well, there is quite a family of us. There were two families to start out with, six boys in one, four boys and one girl in the other, so there were eleven of us in the second generation of farming. They started on the Sacramento River, to help reclaim property in the islands. That's where we got our start, back

Heringer: before the First World War.

Dickman: Were you at the cannery in 1960 to see what came out when they were processing your first mechanically harvested crop?

Heringer: Yes, I'd been there. Fortunately Tri-Valley [Growers] went along with this program in 1960, and they were about the only ones that were taking delivery of mechanical tomatoes that year from our ranch. We were the only ones in the mechanizing business that year.

Dickman: Would you describe your feelings and what you saw at the cannery?

Heringer: The tomatoes we were delivering had been harvested in the morning when plants and fruit were covered with dew. As a result there were quite a few mud-smeared tomatoes arriving at the plant. I was concerned on account of the mud and the inadequate facilities for washing the incoming fruit. However, processors were quick to adjust to the change, and washing with increased water pressure overcame much of the problem. It was evident we also had to make improvements on the machine, which we undertook right away. Most of the problems have been overcome and it is now mainly the management of the harvest that determines how the fruit come in.

Dickman: You mentioned that there were a number of growers back in the beginning, in '59 and '60, who were very skeptical about ever getting a determinant type of tomato which could be mechanically harvested. What were some of their feelings, as you look back?

Heringer: I well remember the first field day we had in 1960 on our ranch between Courtland and Walnut Grove. There was a tremendous interest and we had three or four hundred people in the field to watch the machine harvest tomatoes. This first machine had some rough spots, including fruit bouncing and falling too far, resulting in some fruit damage. Some observers, particularly processors, were skeptical but as we all know the bugs were eliminated from the machine, and today California harvests 100 percent of her processing tomato crop by machine. In 1974 this totaled six million tons.

Processors were reluctant to go to mechanical harvesting in the early days because they had millions of dollars invested in lug boxes. This was a sizeable investment and certainly one that processors would want to protect. There was also a matter of installing facilities at processing plants to handle the 1000-pound bin, which was the first natural development for receiving fruit from the harvester. New schemes for bin dumping and fruit washing had to be developed and installed. This resulted in some dragging their feet for the first three or four years of this new development.

Early tomato harvester demonstration-1960's

Changing Growing Practices

Dickman: Has the use of the harvester changed agricultural and growing practices?

Heringer: Well, quite substantially. It's changed the growing practices because it's helped develop the whole state of California due to the seasonality of early planting, winter plantings. We now start in Blythe in the Imperial Valley, and harvest in June. We then move up the valley into Bakersfield, and the west side of Fresno County in July and August. Then we move further north where harvest goes from August into October.

Mechanical harvesting has been a real fine development for processors because it's resulted in a longer delivery period, creating greater efficiencies in processing plants. This has cut their costs and increased output of California tomatoes. In the old handpicking days we had only two months. We'd normally start around the first of September and be through by November. Rain usually ended the season.

We've gone from 1.3 million tons in 1954 to 3 million in 1964, and 6 million tons in 1974. In addition to the increased volume, our yields have risen during this period from an average of 17 tons per acre to 25 tons per acre with some growers in every district realizing close to, or even in excess of, 40 tons per acre. In the old days we normally figured five thousand to six thousand plants per acre. Now, we grow in excess of thirty thousand plants per acre. Because of the determinant type vine and tendency toward a concentrated maturity, these high planting populations yield a very fine product.

Our herbicide programs have helped tremendously in good weed control and reduced weeding costs. The incorporation of these herbicides results in the emergence of weed-free rows of tomato seedlings. We now thin our tomatoes by machine, or we precision seed to a specified spacing and stand. We may leave as many as three to seven plants in a clump. Things have changed drastically.

Dickman: It's all from seed now, and no transplants?

Heringer: That's right. Everything for processing is grown from seed. The fresh market producers still transplant some tomatoes.

Dickman: What tomato do you use, mostly?

Heringer: The bulk of our acreage still goes back to the old 145 that

Heringer: Dr. Hanna developed at UC Davis. We also have some good pear-shaped varieties, such as VF 13-L, 198, and 65.

Dickman: What is the designation of the pear-shaped variety?

Heringer: We have many varieties; a recent development out of the University is the 198 variety, and it is a fine tomato. It's a little bigger and more round but it's still considered a pear-shaped tomato.

Dickman: Has it changed any practices as far as irrigation is concerned?

Heringer: Yes, as far as direct seeding is concerned, it has changed our watering program. When we used to transplant we'd go in with a rain machine when normally these tomatoes were eight to ten inches high. They didn't take as many waterings as direct-seeded tomatoes do. With seed going in the ground, we normally start the latter part of February and work into the latter part of May. So we have a broader season in which to irrigate. Also we put the seed in earlier than transplants. Consequently a lot of them go in the moisture where we don't have to rain them up. In a lot of cases they'll come up by themselves. The later ones are furrow irrigated to bring up the moisture necessary for seed germination. Rain machines and rain over the tops provides moisture to germinate seed and speed emergence.

Dickman: And you start harvesting when they're at about 80 percent maturity?

Heringer: It all depends on how the tomatoes ripen. Frequently we'll start up at 70 percent maturity. Sometimes we experience a tremendous split set in this state due to climatic conditions. With a split set, maybe 50 to 60 percent are ripe and the rest are grass green. And if you wait for the greens to become ripe, the ripe fruit becomes overripe and often mold forms. Harvesting here becomes a problem, and it is also difficult to get through the California state inspection, which is a third-party grade. So there are times when growers will start harvesting with less than 80 percent maturity. We like the 80 percent figure to ride with, but we've started with 60 to 65 percent in a lot of cases.

Dickman: What can you do with the green ones?

Heringer: There isn't any market for the green ones and they go back on the ground. But, in spite of this and the tremendous productivity Dr. Hanna has built into these 145 varieties, you can afford to leave substantial amounts of green fruit on the ground and still come out with better tonnage than in the old handpicked days.

Machine Improvements

Dickman: Starting with that 1960 first commercial model, how has the harvester been improved over the years?

Heringer: That first one was a great machine. A lot of the things they still use today are on that machine. But we had belts where the dirt couldn't be eliminated. It was almost impossible to pick all the dirt off the machines. Consequently we came in with potato chains to eliminate the small clods that cause processors problems, especially in city processing plants. Dirt clods cause problems with the sewage systems. We had to come up with a program to eliminate dirt in the field and foreign material from the tomatoes. This has been accomplished on new model machines.

We've also increased the harvesting capacity of machines. We've widened sorting belts and improved the capacity of the machines. Our biggest costs are in harvesting. We used to figure for handpicking that half our costs were in harvesting. One way to keep the costs down is through increased efficiencies in harvesting. We've increased the capacity of these machines to about two hundred tons a day, per machine. We used to figure that we were lucky to get through seventy-five to a hundred acres a year with one machine. Now, we think nothing of harvesting two hundred to two hundred fifty acres with one machine. This has come about by lengthening the growing season and by increasing machine capacities.

Dickman: How many hours a day would you run a machine to get that kind of capacity out of it?

Heringer: Well, we normally try to stick to a ten-hour day.

Dickman: How much downtime?

Heringer: There's very little downtime. We don't worry about downtime any more. We wash these machines down every night. We're very careful about that. We make sure they are clean and in good operating order for the next morning. One of the nice things about the tomato machine, is that it was developed and tested under California conditions and manufactured in California. Most of the other machinery we buy comes from the Midwest where it was developed under Midwest conditions. We end up running them right back through our shop and rebuilding them for California conditions and the performance we demand from a machine. The size of operations and conditions vary widely between California and the Midwest.

Dickman: You once said in a talk that maybe they'd use an electric eye to help sort. Are they using that?

One of three Blackwelder-U.C. tomato harvesters at work on Heringer's 600 acre tomato crop, August 1961. The machines were harvesting 10 tons each per hour.

Heringer: Electronic sorting on machines is being developed. It's a very costly operation. In fact, Blackwelder's put one on one of their big machines here two years ago, and we have it on the ranch. It will take out the clods and the grass green fruit, but we still need a sorter on there to pick out fruit with mold.

Changing Labor Needs

Heringer: In 1960 to 1963 we had around one hundred thousand workers harvesting tomatoes, handpicked tomatoes. We used to figure one person for every two and a half acres, but when we were in the September-November category, one man couldn't take care of two and a half acres. This is what the state used to allocate us as far as the braceros were concerned. In the biggest year of the bracero program we had around sixty-four thousand braceros in California harvesting tomatoes, and the rest of the workers were made up of domestic help. Now with the machines we have around twenty-five to thirty thousand domestics in the harvest, and it's a completely new work force. It's been very helpful to the state and to family people. Wives come out and work for several months and kids out of school in the summertime work on these machines. It isn't hard work. It's just a case of selecting color and picking material off the belt. It's all done domestically. But with electronic sorting coming into the program within the next five years, we should be able to harvest our six million tons with approximately six to seven thousand people. This is a drastic reduction in the fifteen or twenty-year period when well over a hundred thousand people were required to do the job compared with the six or seven thousand people we anticipate in the near future.

Dickman: At the present time it's about twenty-five thousand?

Heringer: Right, and the biggest portion of them are women.

Dickman: Did you use women at all in handpicking?

Heringer: Hardly. The law states women can only carry a certain weight and it just wasn't feasible for women to go in the field and do this type of work where fifty-pound lug boxes had to be carried. It's hard and they just didn't come out in the field and pick tomatoes.

Dickman: How many workers did you have handpicking in your own operations?

Heringer: At one time we had over four hundred on the ranch, handpicking.

Dickman: How many do you have now?

Heringer: Well, we have five machines that run on a thousand acres, and each machine would carry around fifteen, sixteen people. So we're down to around sixty, sixty-five people.

Dickman: And these people relate to you and you relate to them?

Heringer: Right.

Dickman: Do you have the same group each year?

Heringer: Each year, yes. They always come back. The housewives and some of their husbands work for us on the ranch year round. They like the fresh air, and the agriculture, and they come out for two or three months in the summertime. Also the school kids; it's been a real revelation for them, because the tomato season of course falls right into that vacation category--July, August, and September --and we've been able to keep the kids busy and out of mischief. I think it's the best thing in the world for them.

Dickman: What do you pay an hour?

Heringer: Well, we're up to better than two dollars an hour, just on an hourly wage, and of course then you add your FICA and all your other programs that come in. And I assume this coming year it will be higher than the two-dollar figure, but this is what we were paying last year [1973].

Field Operations

Dickman: Would you describe the sorters' work as the harvester is operating?

Heringer: Well, you have first the machine operator. He's the top mechanic and the top operator, and you have approximately eight people sorting on each side of these machines, sometimes less. It all depends on the quality of the tomatoes. Sometimes you can roll through those fields where you're 90 or 95 percent ripe with no defects in there, and you may need only five or six on each side. And other times when you're in moldy conditions, you have to pick up the number to make sure the tomatoes will pass third-party grade inspection for the processors. So an average figure would be around seven or eight on each side.

And then, of course, you have the wagons--we're going into bulk handling now, where the tractor pulls the trailer and the truck pulls on a single unit under the headers, and we load directly

Heringer: on to truck and trailers. This saves us a lot of tractor work and a lot of field work, forklift work, in loading trucks with bins, which normally carry around eight hundred to nine hundred pounds each. There have been a lot of changes in the industry, all for the good.

You see, under the old setup, going into 1000-pound bulk handling each harvesting machine requires around three tractors to keep the bins rolling under the machine. When all the bins are filled the bin trailer runs to a loading station, unloads and loads up with empties and runs back to the field and under the machines. It takes around two to three tractor drivers with two or three tractors plus the wagons, plus a forklift operator, working over in the station. And also, those bins cost processors around twenty-five to thirty dollars a piece. Processors had millions of dollars invested in bins; some still do. Going into bulk handling, most truckers had twelve-to-fifteen-ton bulk tanks. This has saved a few million dollars for the industry, just eliminating plywood and bin handling. So there have been a lot of major advancements in the industry.

Dickman: Mike O'Brien from Ag Engineering had done a good deal of work on bulk handling, has he not?

Heringer: Yes, in fact we have an organization, the Canning Tomato Advisory Board, in Sacramento. It is mae up of five growers and five processors that contribute toward the initiation and guidance of priority research programs dealing with grading and inspection problems and systems. The committee is also instrumental in setting standards acceptable to the industry, both growers and processors. Tomato inspection is all done by third-party grading in California. Mike O'Brien has helped us out a great deal, and he's still doing a tremendous job for us.

Dickman: Has there been much change in the inspection codes?

Heringer: Yes, there have been some radical changes in the inspection codes. We used to have color sampling--a completely human decision. Color is now scored objectively by an agtron. The industry has found that by avoiding very ripe tomatoes product consistency and product recovery is greatly improved. Product color is excellent. Fruit harvested just as it has matured goes through harvesting and transportation better. There is less damage. Processors who peel get a higher recovery of a higher quality tomato. The objective scoring of color has improved our yields by allowing lighter colored fruit to be delivered. These contribute greatly to improved product consistency and reduced damage. By setting our standard to assure high fancy color grades, all benefit.

Cannery Operations

Dickman: How has the machine changed operations at the cannery?

Heringer: Processors had to install bin dumpers. Provisions were made to wash bins before sending them back to the field. Improved washing procedures have been adopted. Now with bulk trucks delivering twelve to fifteen tons in one tank, new unloading arrangements have been made to accommodate them. These are improvements that have and are affecting economies in the field and factory. Of course, the tomato itself, being coreless, has helped considerably. Case recoveries have jumped considerably. It's cut down their work force and markedly reduced processors' costs. This tomato is just a much firmer, much finer tomato than the old big beefsteak-like tomatoes that we used to process and that the women had to cut large cores out of.

Marketing the Tomato

Dickman: How about the taste? Has there been any deterioration in taste?

Heringer: Not that I can tell. I can take an old can of handpicked tomato varieties and take the new mechanical harvesting variety and there seems to be no relationship to a taste factor. One thing about these new varieties, on top of being a better tomato for processing that can be mechanically harvested, is that it is coreless. Consequently when they go into the can whole, they come out whole and attractive.

Effect on the Tomato Growers Association

Dickman: How has all this changed the makeup of the Tomato Growers Association in terms of membership?

Heringer: Well, it's amazing how the tomato industry has turned around. In 1961-1962, there were around 2,200 to 2,300 growers of tomatoes in the state of California. Before mechanization came in, all you needed was a tractor and three or four people to go out and plant tomatoes for the processor. In those days most were transplanted. Since those days, growers have had to become highly mechanized, and you have had to spend thousands and thousands of dollars for the

Heringer: harvester, incorporators, and herbicides. In order to buy a machine a grower had to have at least a hundred to a hundred and fifty acres in tomatoes to make it pay. In California we've gone from 2,200 growers twelve years ago down to 595 this last year. These 595 growers are raising around a quarter million acres of tomatoes. So you can see the tremendous changes we've had in the industry.

The mechanization is really the problem that brought it down to that number, because you're like a fruit grower now, only in reverse. You know, when we raise pears and peaches we have a lot of money in the trees, but you still handpick the majority of them. Well, in the tomato industry it costs us growers, say, forty thousand dollars for a machine today in order to mechanize this annual crop. It's like putting in the orchard. So we've shifted this thing around so we're in the same ball park as the fruit growers are, and these people couldn't stand that kind of expense to get into the business.

Dickman: What do they do now, the growers that stopped growing tomatoes?

Heringer: Well, most of them really are not in business any more; they just had to sell it out because of the small acreage they were operating on. And the talk of family farms has changed tremendously. In California, as you well know, our unit return was so small that most of these small tomato operations have been bought out. I'm sure that at the University there are records showing that today you can't stay in the farming business on less than eight hundred acres in California--where it used to be a hundred or two hundred acres. And this is just a change in the way of life.

Dickman: For comparison, take somebody who did have eight hundred acres in those days. What was his capital outlay, compared to his capital outlay now; his gross income then versus gross income now; net income then versus net income now?

Heringer: Well, as you know, agriculture was in pretty tough straits here for a good many years until this last year. In fact, it was just a case of paying the bills and trying to maintain yourself until we got a break in the raw products prices and the grain prices and the alfalfa prices.

Dickman: A real poker game.

Heringer: It was. In fact, that's when most of them went out of business. We went from around one hundred five thousand farms in California in 1960 to around fifty thousand--between fifty thousand and fifty-five thousand, fourteen years later. So we've lost almost half the

Heringer: farmers in the state of California in fourteen years, due to the tremendous financial problem of trying to mechanize to stay in business. There's no way you can handle this labor situation in relationship to the costs of labor against what the raw-product prices were.

Now, as far as what we need today compared to what we needed ten years ago, I really couldn't come up with a figure that I could say. I could go back to my books at home and put it out there in front of you. But we used to figure if we could clear $100 per acre, before taxes, that we were doing pretty well in agriculture here, when we got into these tough years. And, in fact, we were lucky to do it. And if you figure $100 before taxes and you're talking about 100 acres, you've got $10,000. And there's nobody that could live on $10,000 before taxes. And this is the reason that you see this complete reverse of the few farmers we have left in the state, and the growth in it. Nowadays, it's much higher than that since 1973, which was substantially higher than that, and 1974 will also be much higher than that.

Dickman: Has any other crop had this dramatic change that tomatoes have had?

Heringer: No, I've never seen anything like this as far as the state of California's concerned. In this state, as I've indicated earlier, when you go from--say we raised tomatoes in 1938, we were getting thirteen dollars a ton for them at that time; and now we're settling on fifty-five dollars. This is due to increased costs, and the different method of handling, and the whole program.

We're trying to mechanize the peach industry, and we're coming along in fair shape, mechanically harvesting peaches. But people don't mind going out and hand harvesting a fruit crop. They are in the shade, and it isn't hard work like going out in that hot sun and going down a tomato row and stooping and carrying the boxes to the end of the row and carrying buckets and putting them in bins. That's just beyond the call of duty as far as workers are concerned.

We've started to compete with some of the Mexican imports in this country. And the only way we could stop it was to mechanize ourselves and build the industry in this state. See, actually the tomato industry is about six million tons, is about 350 million dollars back to the growers and we've figured about a five-to-one ratio, so you have a billion and a half dollar input into California: glass and cartons and the whole program. So it's one of the biggest and the largest industries in California. And that doesn't even include the trucking industry. In fact we're a little concerned about the trucking industry this year, transportation on this tremendous crop. Because it isn't only tomatoes which have increased

Heringer: substantially, but you have all the fruits and you have safflower and everything hits this program at the same time, so we're looking for real problems in transportation this coming year.

Dickman: Thank you.

MICHAEL O'BRIEN

My First Work on the Tomato Harvester Project

Dickman: Professor O'Brien, how have you been involved in the tomato harvester system and its development?

O'Brien: Well, when I started with the tomato harvester, the machine was practically finished in its development at the University and was actually licensed to the Blackwelder Manufacturing Company to build their first machine.

We had to figure out a way of handling the fruit away from the machine because we had anticipated that it would be coming from the machine at about ten lug boxes, or five hundred pounds, a minute under good conditions. And you just couldn't handle lug boxes that fast very long.

Dickman: A full lug box is fifty pounds of fruit?

O'Brien: Yes.

My earlier work had been with bulk handling of peaches and pears and other fruits and vegetables in bins that were roughly forty-eight inches square and two feet deep. They would hold about a thousand pounds of fruit. So, at the very first trial at the field down at the Heringer Ranch, on August 24, 1960, we got some suzy-bell bins, put them on a trailer that Les Heringer had, and started down through the field; and by gosh it looked like bin handling of tomatoes was feasible. Now, we knew that we were mashing a lot of the tomatoes in bins that deep, but those were the then existing varieties of tomatoes and not bred for mechanical harvesting. And, of course, later developments improved other varieties for "handleability" and resistance to bruising.

We started out with the bins, and, of course, there was no filler on the machine to let the fruit down from the conveyor into the bottom. We developed various fillers as we went along. But, in general, that was my first association.

O'Brien: As we progressed we wanted to find out what the effect of temperature would be on the tomatoes in the bins. The temperature would be determined primarily by the time of harvest. I worked with John McGillivray of the veg-crops department on that phase of handling of fruit.

I think the next date we indicate in our project book here was about the twentieth of September, when we were doing tests on lug boxes: dry bins versus bins with water in them.

Work on Fillers

As we went along, our developments, of course, were to try to improve the quality of fruit or reduce the damage to the fruit. And so our work for the next couple of years was working on automatic fillers for gentler filling of bins off of the loading conveyor of the machine.

Dickman: What are fillers?

O'Brien: Fillers are a means of lowering the fruit down from the conveyor into the bin so you won't damage it too much. There were a lot of different types of those that I tried and discarded. Up to this day there isn't an outstanding filler being used. We have developed some that were excellent, but the manufacturer hesitates a little bit to put them on because the grower doesn't want to use them or pay extra for them in many cases.

Another one that we developed, in 1963, actually carried the fruit down into the bottom of the bin and released it on top of a spreader. This spreader simply divided the fruit so that it would go to each side of the bin and wouldn't pile up in the center. Then we put a sensing booth--an electronic element--on the bottom of the filler so that as soon as the fruit touched the filler, it would raise up. It would raise up out of the bin, just about three or four inches; then the fruit would fill up to it again, and it would raise up again.

Well, this worked excellently in our experimental work, but it was never picked up and used by the manufacturers. We felt that the reason that they didn't make it was that it would add cost to their machine, and they were competitive with other companies then, and the growers might not use it.

Sampling

O'Brien: An allied phase was that of sampling for state grade. We had to

O'Brien: develop some kind of a sampler in order to get samples out of these bins so that state inspectors could grade them. When you had a stack of lug boxes, you could randomly pick a lug box, and you could inspect it and say that was a representative sample. But when you put them in bins you are confronted with the problem of not only selecting one or two bins off of the load, but also getting a sample out of the particular bin.

We had already developed a sampler for peaches and pears where they'd put the bin into the mechanical sampler, inverted it and allowed a fifty-pound sample of fruit to roll out from the top to the bottom of the bin. We used that type the first year, in 1960. (And there was only one harvester then.) Then, the following year, they built twenty-five machines. And when the twenty-five machines were put into use commercially we had to have a sampler to draw representative samples out of those bins.

We developed a cage that would go down into the bin in the water. The forklift took the bin of fruit off the truck and set it down in a tank of water; a little hand-operated crane lowered a pronged cage down into the bottom of the bin. There were fingers inside of these prongs which then closed off the bottom. The crane raised it out and set it over a lug box. The fruit was released into the lug box which then contained fifty pounds of fruit from each bin selected for sampling. That system was used for, oh, quite a few years.

Dickman: Why did you need the water?

O'Brien: Well, that was the only way that you could get the cage down into the fruit without spearing a lot of it. The fruit is rather loose, you know, when you put your hands down into any kind of fruit placed in a bucket of water, you can go right to the bottom. So that was the reason. And, that system worked very well.

Later tests showed that we really shouldn't put the tomatoes in water because it starts some kind of a chemical reaction in them: it starts them to turn sour. They start this process rather soon.

Then there was a question about clods and soil being delivered in the bins and, of course, when you set it in the water it dissolves and you don't get any of it in the samples. And so then they went to sampling dry because the cannery was really buying quite a lot of soil that would inadvertently get into the bins even though the sorters on the machine were trying to sort it off.

In order to find out how much clods and soil were there, they inverted the bins--the same way they had been doing it earlier. Pouring it out on a table, they could determine the amount of soil contained in that sample. So that type of sampler was used as long

O'Brien: as they were using bins, and is still in use wherever bins are being used.

Central Sorting

Starting about 1967, there was a development in handling that should be mentioned and that was central sorting of tomatoes. The idea was that you did not do any sorting on the machine; you harvested the tomatoes into bins or gondolas, brought them into a central area, dumped them into water, then ran them over sorting equipment and put them back into bins and sent them off to the cannery.

However, there were problems with that procedure. The procedure where you dumped the bins and filled them in between harvesting and the cannery caused a lot of damage. It did deliver clean fruit--very clean fruit, there's no question about that--but the added damage and added time resulted in a lot of loss. The growers objected because they sold less fruit and the canners objected because of the high incidence of damage. To make a long story short, I don't know of more than one central sorting unit that's being used at the present time. There were about a dozen at one time.

Dickman: Did that eliminate the use of the sorters on the machine?

O'Brien: It did. In fact there were a couple of machines that were built for central sorting, without sorters. But those went out of existence very rapidly, simply because there was a lot of tomato loss--in fact, a high tomato loss. Sorters picked out a lot of fruit that would have been good fruit to can, so the grower actually sold quite a bit less fruit from his field because of the inefficiencies in the system. So he was getting less yield and the canner was getting less tomatoes, but the canner <u>was</u> getting good fruit. But it was bruised, quite badly, thus increasing his losses during washing.

Bulk Handling

In 1968, we began the transition from handling tomatoes in the one-thousand pound bins to complete bulk handling in twelve to thirteen ton truck trailers. Experiments were conducted on a small scale for feasibility purposes. In 1969, we started research on a sampler that could be used for both the one-thousand pound bins and also the entire truck beds.

Dickman: How many tons is a truckload?

O'Brien: One trailer will have about thirteen tons in it. Two trailer loads

O'Brien: will be about twenty-six tons of tomatoes.

Dickman: So you went from fifty pounds to one thousand pounds and then thirteen tons, over a period of about ten years.

O'Brien: Yes, fifty pounds and then we went to one thousand pounds in the bins, and then it's to a big bin so to speak (the entire truck) that holds about thirteen tons. And, with that system, you couldn't put the fruit into water for sampling, you see.

So, we had to develop a sampling system whereby a cylinder was lowered from an overhead crane down into the load. It was an eighteen-inch diameter cylinder. When it reached the bottom of the load, some gates that had been fitted around the inside periphery of this cylinder were partially closed at the bottom--just enough to bridge the fruit. Then the cylinder, which held two-hundred pounds of fruit, was withdrawn. We would then swing a lug box, fitted with a cone with a hole in the top of it, under this cylinder and release the fruit; the center core of fruit in the cylinder would drop through the hole in the cone into a lug box, and the fruit around the periphery of the cylinder that had some cut tomatoes would fall to the outside and back into the load. That is the system that is being used for bulk trucks and also for bins now. They have to use a smaller cone for the bulk than they do for the bins because they still want to get fifty pounds of fruit into the lug box. Therefore, use of a cone with a smaller opening permits collecting a deeper core while still collecting a fifty-pound sample.

When we were starting this sampling phase, we tried a vacuum sampler as well as this mechanical tube sampler. As for the vacuum sampler, while it worked after a fashion, it did too much damage. The tube sampler did work well enough to continue research on it, and when I went over to report this to the Processing Tomato Advisory Committee, I reported to them that during the two years they'd given us about $40,000, and we just had damn little to show for it.

The reaction of the board you might think would have been critical, but it was just appreciative that somebody'd tell them that they spent their money and they didn't have anything except a hope to show for it. But the next year we were really proud of what we had gotten out of those two years' research. We had the sampler that we're using today, and it was very efficient. It has cut their cost of sampling to less than half and, more important, it provides a means of getting representative samples from bulk truckloads of tomatoes.

Bulk Handling Fillers

We measured some loads in our bulk handling research work

O'Brien: where the damage caused up to about seven inches of juice in the bottom of the trailer. Now that seven inches of juice is in tomatoes so that it is about one and a half inches of actual juice. But that figured out to be close to 4 percent actual loss. Now we were getting that same amount in bins--the same as we are in bulk now; before, it was leaking out of the bins and we never noticed it. I also should point out that when we first started bulk handling, the trucks going down the highway would be oozing a lot of juice. The juice would be leaking out along the way and getting on windshields. Wherever there was a sharp corner, why, the juice would run to that side and spill out on the highway, and the Highway Patrol took a rather dim view of this. But these were some of the problems that you have to work out as you go along.

The work now is to reduce the amount of loss, because when that load goes to the cannery and gets dumped with the juice in it, it goes into a flume and nothing is recovered from that flume other than the whole tomatoes. All the juice is lost. So people in the cannery were suffering about a 4 percent loss in juice and the solids from the tomato. The juice contains the pectins as well as just the liquid, so that was kind of serious.

Dickman: What steps did you take to reduce the amount of lost juice?

O'Brien: All right, the one thing that was probably more effective than anything else--which is still in progress now--is to get the people to lower their fillers down into the bulk truck and lay down a pad of tomatoes along the bottom of the truck, and then hold the filler down as close to the tomatoes as they can while they fill the truck by moving back and forth along it.

Still, in too many cases they hold the filler up to the top of the truck and drop the fruit about four feet. When you're dropping it on other fruit you can drop it twice as far with about the same amount of damage, because each fruit will absorb about the same amount of energy.

Dickman: So the growers didn't use fillers at all when they were using bins. But they do use fillers, sometimes incorrectly, now that they're bulk handling?

O'Brien: Well, after a fashion. They used fillers but they never really addressed themselves to that problem--not really.

The biggest thing now with bulk, of course, is that they can put a kind of a gooseneck conveyor on the harvester and let it stick right down into the truck. And by putting a breakaway mounting on the conveyor, so that if it hits the front or the back of the truck, it flexes and won't hurt the machine any. Quite a few of the growers are putting these breakaway conveyors on now, with a continuous flight from the machine over into the truck. We think that's going

O'Brien: to significantly reduce the damage. That was the work we did last year.

Color Sampling

Dickman: Has this efficiency that you've effected in sampling changed the inspection code any?

O'Brien: Yes, it has in that it dovetailed with sampling for color. That's another development and I don't know whether you're going to check with Sherm Leonard of the food science department on some of these developments.

Dickman: Yes, I think so.

O'Brien: All right, he will cover that because the state Department of Agriculture and the food technology department actually developed the comminuted grading for color. They didn't develop the sampling. They developed the grading for color with a comminuted sample, and I developed a sub-sampler and modified their procedure.

Dickman: What does comminuted mean?

O'Brien: Comminuted simply means that you grind it up and you look at an average of all the sample rather than individual fruits. It was a very fair system. They blended a sample of the tomatoes in a laboratory blender, then de-aerated it in a flask before placing a sample in a color measuring instrument. The procedure required eight minutes. I had the thought that, if you didn't put air into the comminuted maceration, you would not have to take it out later. So I devised a blender that would comminute the sample in a vacuum, thus cutting the time to two minutes and speeding the trucks through the sampling and grading procedure.

The thing that needs to be said about the development of the tomato harvester is that Lorenzen and Hanna made up the first scientist-engineer amalgamation whereby the scientist and the engineer cooperated on producing a plant and a machine that were compatible with each other. And the important thing about this is that this was really the first time this was done. It has led to that type of cooperation all around the world. That fact may have been said by other people, but it should be put in very clearly that they were the leaders in combining plant science and engineering to produce a compatible machine and plant product.

ROBERT L. BUTTON

Dickman: Please identify yourself.

Button: I'm Robert Leslie Button.*

Dickman: You are in the manufacturing business?

Button: No, I'm really not; I'm involved in agriculture, as a farmer. I've been farming now for twenty-nine years, ever since I got out of the air force in World War II. I was born and raised on a farm. I went to the University of California at Davis--"Aggies" at the time--for a year and a half. I took courses in agriculture and agriculture engineering.

Dickman: When was that?

Button: The spring semester of '46 is when I started.

Dickman: When you got out of the air force?

Button: Yes, after I got out of the service. I was farming and also had some trucks at the time, so my schoolwork lagged and I had to quit one or the other. So I quit school.

Dickman: Did you say that you were in ag engineering?

Button: I did take courses from Jim Tavernetti; some of the nondegree work.

Dickman: What have you been growing primarily?

Button: Well, I've been in the row crop business, alfalfa and orchard, mainly. Row crops of all kinds. Of course tomatoes are most always one of our best crops as far as cash returns and net returns, if you're fortunate enough to raise a good crop. We must have tomatoes in Yolo

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*Robert Leslie "Bob" Button died on December 3, 1975, in the crash of his private airplane near Davis. His oral memoir was reviewed and edited by representatives of his estate before it was returned to the Oral History Center with approval for inclusion in this series.

Button: County and in California to support the tax structure and maintain a strong agriculture. We must make money in order to stay in business. Tomatoes have been one of our major contributors to a good economy for the county, expecially Yolo.

Dickman: Are you talking about processing tomatoes primarily?

Button: Processing tomatoes, yes.

Dickman: Do you raise fresh market, too?

Button: No, I've never raised fresh market tomatoes. Strictly processing tomatoes, for the canners.

Dickman: You were handpicking them?

Button: Yes, I started out raising tomatoes from seed in a hotbed and transplanting to the cold frames, and then from there to the field. That was in '48. Also our sugar beets we were digging and loading by hand. Everything, of course, was done by hand in those days. And as time went on labor became a little more difficult to obtain. There were so many government regulations that it was impossible to live with them. I spent nine years as a director of Yolo Growers, which is an organization to procure Mexican nationals. And between the Mexican government and the American government and all the red tape, it became an impossibility to comply with all the regulations. You could go to anybody's farm and find a violation. Operating under these kinds of laws and restraints was very difficult.

Improvising a Tomato Harvester

This is really what brought about the development of the tomato harvester. As any machine is developed, it is usually developed out of a need or a crisis of some kind, so there was thought being generated as early as '58 toward mechanically harvesting tomatoes someday.

Dickman: Were you aware of Jack [Gordie C.] Hanna's work on the compatible tomato?

Button: Not in '58. However in '60 this became a reality to me, that it would be accomplished due to the determinant type of plant Jack Hanna was developing. The one-time-over harvest operation would then become a reality.

Dickman: Had you seen the prototype that Coby Lorenzen had developed?

Button: No, I never saw any harvester at all out in the field or in any of

Button: the buildings here in the University. I was just never fortunate enough to come over and look at. But, I did see a movie (somebody from Chisholm Ryder or the University of Michigan. I don't remember which one it was or a combination of the two) at Tomato Day, I believe, in '59. (I could be wrong about the year.) There was a fellow that flew out here on an airline and he had his films and he was going to show us what they had done as far as mechanical harvesting of tomatoes. They had done work toward mechanization and had a small machine. Some of his baggage got lost on the airplane so he never had all the film, to show, so we didn't get to see all the work they had done. But they did show about a three-minute film of their machine operating, separating the vines from the tomatoes. I'm not sure of the variety they might have used,--Napoli; or one of the varieties that they raise in the East. It was a very simple machine, but it did really show that mechanical harvesting could be done by putting the plants with tomatoes attached together in the machine; out came tomatoes in one place and vines another.

So this really was one of the contributing factors to stimulate me in my work in developing a tomato harvester. Of course my knowledge that Hanna was working on a tomato and that Lorenzen also was doing development work on a machine was reassuring to me that we would soon mechanically harvest tomatoes. Not that I thought that I could do it better; I think I just thought that I'd like to accept the challenge and see if I could develop a machine that would work. I had developed other machines prior to this.

Dickman: What kind?

Button: Bean harvesters, cultivators, and hay equipment mainly. My parents and my grandparents were mechanically inclined and I guess I just inherited certain abilities. I think some people are good at some things and some are good at others, and so on. I might have a little knack about mechanical contrivances.

I started making drawings of the tomato harvester. I had a real good drafting teacher in high school, by the name of Bill Pugh. He managed to pound a few good things into my head. He taught me how to be a draftsman.

Dickman: Was that in Winters?

Button: Yes, that was in Winters.

Dickman: When did you begin to make drawings on the tomato harvester?

Button: Nineteen sixty is when I first started these drawings. I had drawings that dated back earlier than the fall of '60. I remember when I first started drawing there wasn't any big rush. And, in the fall

Button: of '60, I really got serious. Then in January of '61 I started to build the machine. And I had layout drawings only; no detail drawings for a shop because I knew I was going to build it myself, so I didn't have to detail everything. I built it right in our own farm shop starting the first of January '61. I had a fellow working on the farm as a farm mechanic. He was a rather elderly fellow at the time, but he was very intelligent. Merle Rogers was his name, and he helped me build the harvester. He was a good welder and he could think. We'd get a problem every once in a while and we had to twist our gray matter around a little to make a part fit. He was real good. And one of my neighbors, Bill Singleton, came in June and helped me finish it because, as with anything, it always is difficult to complete on time. But we did have it done in the middle of July and it was complete and ready for the harvest in '61.

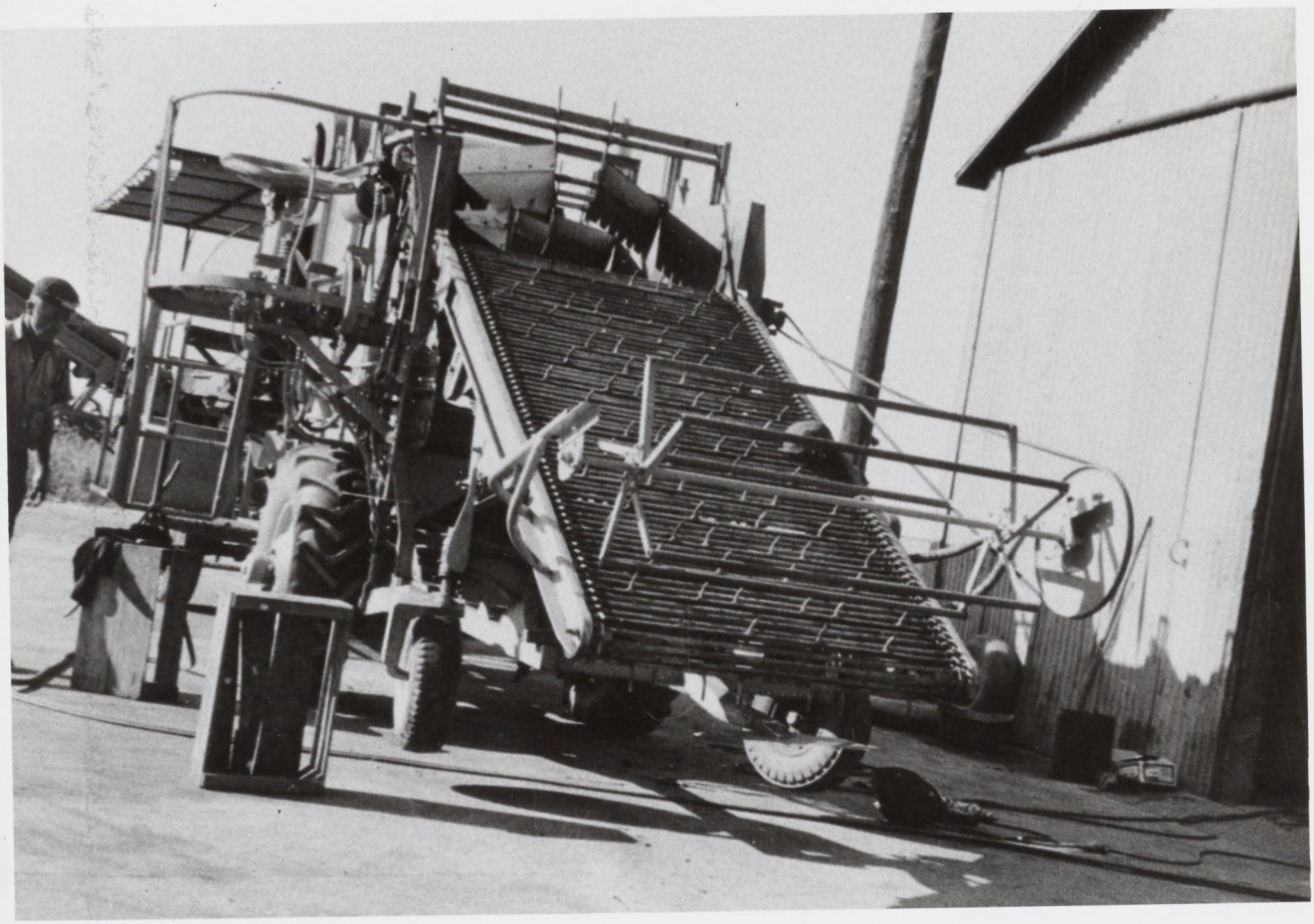
It was a problem to finance this project. We financed all of it ourselves from farm income. I remember when we got to the end of construction we came to the power steering unit. And shopping around for power steering units, why, I found out that they cost a couple hundred dollars. So, I thought, I've got to do something better than that. We had an old four-way hydraulic valve there in the shop and a cylinder off of a cultivator, and I put the cultivator cylinder on the tie rod in the back of the machine where the steering axle was, and put the four-way valve underneath the operator's platform and put a rod up there. So, when you wanted to turn to the right, you push the rod to the right, and when you want to turn left, you stuck the rod to the left. It didn't have a wheel on it. We did that for about forty-five or fifty dollars. This is how we ended up in lots of cases--improvising--because of the amount of money we had invested. Of course, you always get kind of disgusted or discouraged as you're building a piece of equipment, especially if it takes a lot of time. It took a lot of time away from actual farming.

Dickman: What do you figure that first machine cost you? Not in time, but just in actual cash you had to put into it?

Button: I had close to twenty thousand dollars in that machine in 1961. That's not figuring my time or the loss of the higher crop yields that I should have got if I hadn't been building the tomato harvester. That's just the actual men's time, wages, materials. If you added all my costs of development, it would be greater than fifty thousand dollars.

I have to give credit to a lot of my friends that knew I was building the harvester who came and in my moments of despair gave me a little pat on the back, and gave me encouragement to continue. They are too numerous to name, but I do have a lot of close friends that really gave me a lot of moral assistance.

Dickman: Did any of them invest with you?



9/12/61: Button's tomato harvester

Button: No, none of them invested money but they did invest a lot of . . .

Dickman: Time and know-how?

Button: Well, the time--they were there and they helped me talk about things. Anytime you talk to anybody that's intelligent you're bound to pickup some good points, whether it's about a machine or just the general farming practices. It all helps. We built the machine in an open shop on the farm and several farmers heard we were building it. A lot of them came to visit me. I never kept any secrecy on the thing at all. I didn't really think I had anything to hide. And, consequently, being really busy building the machine and farming, I didn't have time to look at anybody else's equipment, such as the University or Blackwelder. Of course I wouldn't dare have gone to the Blackwelder plant, because they wouldn't have let me in the door anyhow, rightfully so.

Field Testing the Early Harvester

Anyhow, we got the machine in the field and I think it was around the twentieth of August, 1961, before our tomatoes were ready to harvest. Three of my men and my mechanic went out in the field the evening before and we ran it a little ways to see if it would operate, because we weren't at all sure. We saw that the machine would operate with a certain modification on the header, so that evening we fixed that. The next morning our crew was there and we harvested all day, eight hours, and the machine functioned unbelievably good. We didn't have any stops other than normal cleaning. We worked all day and we got one twenty-two ton load of pear tomatoes that graded .01 percent. That was very discouraging because we thought we could do better than twenty-two or three tons. We only had ten sorters on our machine, which was a drawback as far as speed. So the next day we went out and we decided we'd shoot for about a 9 or 10 percent grade. We got the machine out of low gear and we did three loads the next day, and we got our grades up to 7 percent. We were very happy we could do around seventy tons.

From there on out it has been a continual development. We worked that year with several manufacturers that are in the field now as competitors. Blackwelder's engineers were on our property almost daily for probably thirty days out of the forty we ran that year. The industry personnel were there a lot. Food Machinery and Hume had their machines in my fields. They couldn't run them anyplace else; nobody wanted any part of them. It wasn't a very popular thing, you see, in '61. The canners didn't want anything to do with bins; they didn't want anything to do with us. They didn't want any dirt and, of course, rightfully so--they shouldn't have any dirt. That year we delivered a better product than we ever did by handpicking. We were fortunate that we delivered a

Button: clean product to the canner.

Early Canner Reaction to Mechanically Harvested Tomatoes

We delivered to two canners: California Canners and Growers and Contadina took the most of them that year. Contadina was the only canner, really, at this time--and I'm not ashamed to say it--that was really interested in helping us. A fellow by the name of Ray Warren was the plant manager at Contadina at the time. I think he's the head of all their canneries today--I haven't seen him for years. But he was very interested and is a very mechanically minded person. And he could see the light. He was trying to help us, really. He helped me with encouragement. He was even out in my shop several times watching us build the harvester. So we delivered that year to Contadina.

Dickman: What was Contadina's reaction to that first load?

Button: They were real pleased with it. Mr. Warren was real pleased with it. He encouraged me and, as I said before, that was what we really needed at this time because the other canners were not giving us that kind of cooperation.

Back in '62 we lost a field of tomatoes because we gave it to Cal Can. We are members of Cal Can; they wanted the field of tomatoes for research, to further benefit Cal Can. Being a member of that canner, I thought, rather than giving it to Contadina we'll contract the field to Cal Can. That ended up being a mistake because the head of the Thornton Cannery at that time was so determined not to allow mechanical harvesting to become a reality that he wouldn't accept the fruit in bins. He had a field man who kept coming and telling me all the time that the plant was plugged, or this was wrong or that was wrong, everyday, and the power was blowing out, the dumper was haywire. He had so many excuses that, after a week, this began to even become evident to this old farm boy that they were trying to stop me from delivering. They at last got courage enough to say that they didn't want bins. Of course, the bracero program was still active in '62. You couldn't get the men because you had to order them six weeks in advance. We went to the field and we tried to harvest the tomatoes in boxes with the harvester. We did harvest a few in boxes and they got rejected. They were overripe, so we just had to pull out of the field. That's another one of the losses you get for trying to help your fellow man.

We did harvest 115 acres that year with that one machine. We did do some modifications on it the next winter and we used that original machine through the harvest of '66. We picked as many as

Button: nine loads a day with it--nine twenty-two ton loads.

Dickman: Were there still ten sorters?

Button: Yes, there were still ten sorters. We haven't used it since '66. We don't even take it into the field as a standby anymore because we have enough of the later model machines that are capable of doing the job.

Dickman: When did you decide to start making them commercially for other growers?

Working with Bennar-Nawman on Commercial Production of Harvesters

Button: At the end of '61, a representative of the Canners League approached me--I should remember his name, too. An elderly man. He inquired as to what my thoughts were regarding my machine. Several of the canners had come to him and said that my machine was delivering a clean product and they would like to see it produced commercially. I really hadn't given it too much thought. I thought it would be nice, or course, but it would be kind of dreaming a little, you know, could this ever become a reality? They talked to me and advised me that I should produce my machine commercially. Meanwhile, I had taken out patents because my friends told me that I was a damn fool if I didn't take them out; the machine was working so well. So I did take some patents out. I applied for them the fall of 1961. The National Canners more or less recommended Bennar-Nawman Company in the Oakland area. We went into an agreement to build the harvesters commercially. They had never had anything to do with in-field machines although they were very good at building canning equipment. That's how and why I was referred to them, because the canners knew their capability with building canning equipment.

So we started building a prototype. This was'62. I'm probably not the easiest person in the world to get along with and I had some problems with their engineer. He was an ex-navy man and . . .

Dickman: And you were air force . . .

Button: Yes (laughter). He had seventeen years in the navy, as an engineering officer with a rank of a commander. You know, the navy engineering is a lot different than tomato field engineering. So we just had a difference of opinion, a conflict of personalities. He was redheaded and I'm Dutch. We had some problems. It's kind of funny now, but looking back, I was trying to promote the harvester and they kept telling me they wanted to put box-handling equipment on the harvester. I said that that was going to make it awful clumsy and it's going to make it hard to manage; it's

Button: going to slow the capacity of the harvester way down. And the farmers--by golly, I know myself--want that harvester to run fast and do a clean job and keep our costs down. We don't want to be fiddling with boxes.

Anyhow, they kept talking boxes and I could never understand why. But later on it came to my attention that the Wooden Box Institute had pumped in several thousand dollars into Bennar-Nawman Company to build a machine that would adapt to automatic box-handling equipment. Well, that's politics in business, I guess. But, I wasn't advised. As we have found out, boxes were wrong. And the canners, were against bins. The Wooden Box Institute had a valid reason to support a machine that had box-handling equipment on it. Now we know bulk handling is here--ten, twelve years later. And probably a great percentage of it will be bulk in '75. You see the canners were committed to the fifty-pound lug, which probably only holds forty-three pounds of tomatoes. Now we put thirteen and a half to fourteen tons on one trailer and go down the road with a set of doubles as high as thirty tons of tomatoes. You can see the whole theory and thinking has changed. At the infancy of the program, when they put the box-handling on the machine, it did make it very bulky and very hard to manage and lowered the machine capacity along with creating several other problems.

We were running into difficulty, so we struggled along for a year or two and then, in 1963, they brought a machine into my field that was a real abortion. It had all this box-handling equipment on it. I ran it in my tomato field one afternoon and it was obvious to me and my people that this machine was not going to make it. So that evening we had a little talk. My people were real upset with me that I couldn't control the building of the machine. I said, "Well, it's their money and it's awful hard for me to control, especially since we're having some problems." So they said, "By God, if it was me, I'd go out there and take my name off the thing." And I said, "Well, you go right ahead out there and you paint it out." So they went out that evening and painted the "Button" part off the Bennar-Nawman machine. So we had both fun and sorrows in the whole thing. But it was an interesting development.

At the end of the fall of '63 it was obvious that we were not going to make the thing work. I sat down with the senior Nawman and his son-in-law and some of the people involved and just laid the cards on the table. They were having lots of union problems down there in their plant, also, so they were probably equally as glad to get rid of me as I was glad to get rid of them.

Teaming Up With the Johnson Farm Machinery Company

I stumbled around for a few months, wanting to build a second

Button: generation harvester, but I didn't know who to join with. I had several companies that wanted to join with me. I spent time in Los Angeles, time back East, and time locally, trying to work out some kind of an agreement with the right people. It isn't always the wisest to enter into an agreement with the company with the most capital; it is people that really understand the problem and who are willing to work with you that really counts. I don't believe there's any need in me telling you all the people I talked to. There were several of the large manufacturers and some of the small ones. Anyhow, I signed an agreement with the Johnson Farm Machinery Company in Woodland, to work together with them and build a tomato harvester. The Johnson people have got a farm background and they're very honest, hard-working people. They understand the farmer's problem along with understanding manufacturing problems. I talked to Mr. Roy Johnson once out at the fairgrounds very briefly about it. I later talked to Roy's son, Bernell Johnson. In April of '64 we sat down to do some serious negotiations. They had just moved into their Woodland plant. It was a nice new building; it wasn't big but they had room to grow. Roy Johnson's ability as an engineer, as far as I'm concerned, is unsurpassed. And, Bernell Johnson, as general manager of the company--with their attitude and their abilities, even though they were a small family-owned company, we joined together in an agreement to produce the second generation tomato harvester that I had layout drawings on.

We entered into that agreement; and then, in the middle of April '64, I sat down and worked shoulder to shoulder with Roy Johnson on the drafting board for two and a half months, detailing and figuring out what kind of component parts for sure we would use. I had several of them listed, but we went over all of that and agreed among ourselves which ones we would buy to build this second generation harvester. The blueprints wouldn't even be dry when Bill Turold (who is now the plant superintendent) would have them in his hand and run outside to build the harvester. We were building it under a lot of pressure because we definitely wanted it in the fields for the '64 harvest. I can always say that I had the utmost cooperation from the Johnsons. They were completely new to the tomato harvester but they were willing to gamble on what I would say would work.

Dickman: What had they been manufacturing previously?

Button: Almond harvesting equipment. They had a real good cultivator sled--what they call a plantivator--which is very successful in the row crops. It's been developed into a much more sophisticated machine today than it was then. They also had sickle tool equipment. They were a relatively small company. They have now enjoyed a fabulous growth, but it's come out of hard work and high risks, as any business is. They can only be commended for their abilities. They really helped; they made it all possible.

Rivalry Among Manufacturers

Button: After we put the first of the second generation machines in the field, oh, I'd say around the first of September '64, we had a field day program. I was out in the field the evening before by myself doing some last minute adjustments and getting things ready. Competition, of course, was getting pretty keen at the time. Some of the other manufacturers weren't too happy to see us coming up with another machine, so young Bert Blackwelder came into the field that night. I told him that tomorrow would be our field day and I would appreciate it if he would stay out of the field with his people and let us have our day, and that we'd invite him over to inspect our machine in a few days. So the next day we had our field day on the Griffin Ranch and there was several hundred people out there watching the machine operate. We also had a real good field of tomatoes to harvest: around twenty-eight tons of VF 145-7879. We were running rather fast with the machine. The belts were full; fruit was going into the six-bin trailers that I also developed.

No way can I disregard the thoughts and ideas given to me by Jack Hayes down in a beet field one day in the early spring. We were talking about ways of handling these bin tomatoes other than by taking them off by forklift once we got them loaded. We talked about the feasibility of having a dump trailer that had an automatic latch in the back; as the trailer dumped, the latch would contact the ground and trip the gate and the six bins would flow out on rollers and lay on the ground. I took a drawing board to it and came up with a six-bin trailer. Of course nobody had seen those work, either. The farmers had a good day that day. They could see that these developments were going to become a reality. With a machine running thirty-five tons an hour down the row (which in that day was high tonnage) and the six-bin trailer laying bins out in the bin yard in a row without touching them with a forklift, we had a real good day.

I won't keep it a secret. Bert Blackwelder came that day to the field with all his engineers to watch our machine run. John Wetzel came out in the field and told me that they were there. I was out in the field so I jumped in the pickup with him and we went back and I politely told Mr. Blackwelder to please leave the field, as I had requested them to do the day prior. You know, you have to bring to light this competition in order to get the true story. It wasn't all peaches and cream, and of course this brings hard feelings. There are pretty deep wounds between different companies--things they say and things they do to try to impair a person's growth or ability to perform.

But we've managed to survive that so far. The Johnson Company sold twenty-five production machines in 1965. We had some problems, believe me, but we managed to overcome them. In 1966 Howard Johnson,

Button: Roy's other son, sold his farming business and joined the farm machinery company as the head of sales. That year we built fifty harvesters. In '67 we made some changes and we had some problems, but we managed to again overcome them. In 1968 we had a real good harvester, and from there on the machines have been functioning properly. I think we will have seven hundred fifty or eight hundred harvesters in the field at the end of '75.

Dickman: How many did you make last year [1974]?

Button: We made 100 last year. We're making 140 this year [1975]. We have them in Portugal, Spain, Israel, France, New Zealand, Mexico--Mexico took two '75 production harvesters this last month.

In 1966 we took harvesters to the East Coast and that was my first experience in working in the mud, which was a real eye opener to me. They don't farm like we do; they don't grade like we do. They don't have to pass a state inspection like we do with our product. The harvesters were sold to Libby, and they were running in fields that had four inches of rain Sunday. We were working Wednesday. The harvesters were sinking down a good foot into the ground. Needless to say, it was a muddy situation. But it did bring on some new ideas and new technology. I came home and we changed some of our designs a little so that our harvesters would be capable of running there in the mud as well. It has helped the farmer tremendously, that these machines will operate successfully in wet ground.

Engineering Problems of the Early Harvesters

Dickman: Going back to around 1961, what were the major problems in developing the machine? What changes and modifications did you have to make?

Button: Well, not being a formal engineer, I have to learn things the hard way. I never heard of anything such as a pitchline, and I've been around harvesting equipment all my life. I never did have that problem brought to my attention. We had a conveyor underneath the separator that was doing the most beautiful job of holding the tomatoes until the return side, and it would then drop them out. I thought I'd close up the space a little bit. I put a whole lot of skid tank hose on the bars to make them smaller. But that only increased the problem because it gave them a larger area to grip the fruit. You couldn't have done it any more gently with your fingers. It didn't damage the tomatoes; it just dropped them out

Button: on the ground. I had to change the conveyor, adjust the pitchline to the sprocket, and then it didn't do it. That was one thing that we did.

The first evening we went out to the field, Mel Zobel, our farm advisor, was there. We asked Mel to come and watch because he has always been helpful to us. We had straight teeth on the pickup header when we went into the field. It picked up great on the lower end, but on the discharge end the teeth would hold some of the vines and cause them to back feed: it was pulling the vines down and dropping them on the ground. We only went about fifty yards to find out that wasn't going to work. I had been thinking that this would be a problem, so I had my welder and torch there. I grabbed a torch and a piece of pipe and I jumped up on a header frame and I bent all its teeth rearward, which is the opposite way you'd think they should go to pick up anything--but it's the right way if they're going to release something. That ended up being one of the patents. Just something like that is how things come about. So we bent the teeth back and then ran the harvester and found that it was picking up correctly and also discharging correctly.

We also had a little problem with the feed right on the lower end. We didn't have a reel or anything to assist the conveyor, so we thought, well, we'll just make us a pipe reel tonight and set it on the front like a grain harvester and let it put a little downward pressure and rearward motion to coincide with the conveyor and it would help load. So that evening we took the machine out of the field and took it back into the shop. We started welding, cutting, and bending, and in just a little while we had a reel made for it. We stuck a pulley on the top of the conveyor shaft and put another pulley down on the header reel, and turned it with a crossed V-belt, and then went out into the field the next morning and we didn't even adjust it. It was just luck.

Every part of the harvester that came in contact with tomatoes, I'd taken sponge rubber and glue and glued sponge rubber all over everything that was moving and everything that would touch tomatoes, because I was so conscious of damaging the tomatoes. After about half a day of operation it became very evident to us that anything you put on there that's softer than a tomato isn't going to stay. So all of the sponge rubber started coming off. And by the end of the season there wasn't any sponge rubber to cushion the fall or to cushion the tomatoes. It became evident that that wasn't necessary in the first place but, to start with, everybody was so concerned about damage to the tomatoes. We worked out on the discharge end of the unloading elevator and we had a couple different ways of slowing down the tomatoes before they go into the containers. We divided the flow within the discelerator, which helped us more than any other way of

Button: doing it, bringing it down and dividing it, and making two piles instead of one in the bin. Today you see some of them going that way. There's several different ways of doing it. However, none as well as the industry would like.

The problem, also, of running a wide belt that's got short centers on the drive pulley and the driven pulley--like on our old machine, it had a four-foot-wide belt; I think the centers were about twelve feet, and only a 3 1/2-inch diameter pulley--the alignment of that belt almost caused me to lose my sanity. Before we ever went into the field we were running these belts and running the machine to see if it functioned properly. I could never align the belt. To me it was ridiculous, because I aligned belts all my life, and drapers on harvesters, and there's a way to do it, a simple way of doing it. But I could never make this do it. After many hours of thought I felt the only way I could keep this belt running straight was to put two little rollers on the lower side of the drum, to feed the belt, actually to force the belt to run in alignment. We did that and that saved the day. I later found out, after talking to some of my friends, that this is a very, very difficult thing to do. And if you were designing around it you'd probably try to design for a bigger drum. I didn't have room to do it nor the knowledge that I should do it. So these kind of things come into play in building and designing anything.

Dickman: What did you do that delivered such clean fruit?

Button: I believe the header pickup was one of the main contributors to that. Another thing was that we had a real short drop throughout the machine and particularly under the separator. Another thing which was very evident was that the machine was what we all called a straight-through-flow machine. We didn't turn the fruit around and deliver the fruit to the bins on the front of the harvester; we delivered the tomatoes to the rear of the harvester. This kept the tomatoes from making another 180 degree turn, which was going to take a drop or a shear or something to turn them. If the tomato is turned with a shear, which is commonly used, it rolls the tomatoes and covers them with dirt. If there's any mud on the belt it makes them look like M & M candies.

Patent Problems

Dickman: Have you had any patent problems?

Button: As of this date, no, we haven't. We haven't had anybody infringe on our patents. There's always a possibility of this; there's so

Button: many ways that some of the larger companies will try to discourage smaller companies to go into litigation against them, because you can't do it for less than $150,000 today. So the smarter companies try to keep their nose clean and don't get involved in other people's patents.

Dickman: Have any of the other companies claimed that you were infringing on their patents?

Button: We have a little problem with Food Machinery now. One of the developments that we put on the harvester in 1970 we didn't even try to patent because we thought it was irrelevant. There really isn't anything unusual about it; it's just common sense. We do it completely different than Food Machinery is doing it. We're taking dirt out mechanically and they're taking clean tomatoes out of a dirt belt by hand. That is just about how different it is. But anyhow there is a conflict there which will probably be solved one way or another in the next six months. We have strong enough feelings in our organization at the present time that we will go to court. But other than that we haven't had any problems. With my original patents we haven't had any problems.

Recent Trends: Mechanization, Labor, Consumers

Dickman: What will the machine sell for this year?

Button: They are selling for around sixty-three thousand dollars.

Dickman: Will the new machines have any devices for automatic sorting?

Button: We have five going into the field in 1975 that have automatic sorting devices. They will work, I'm confident, very satisfactorily. They were developed last year by the Johnson Farm Machinery Company, and I did a lot of in-field work with the equipment. We ran it on a commercial basis in our own operation for a week continuously without giving it any extra help. We learned a lot from that. We are in the process of continually improving these methods and we are making that one of our maximum efforts this year in our shop to come up with maybe even a phase three-type sorting machine. We feel we've got phase two on the electrically sorting machines this year, because last year was phase one. This year we've come a long way. They will be a lot better than they were last year. And we hope that we will be able to jump even into phase three in the next few years. We'll have a really good automatic sorting device. This is where my area of most concern is now, being a farmer. This has got to become a reality and right now.

Button: We, on our own farm, have not had any labor problems. We pay our people well. We pay the sorters by contract. This year [1975] one crew made as high as ninety-five dollars per man per day on an eleven-hour day. Being a farmer, I'm independent in my thinking: I don't want to have a union steward telling me how to run my farm. It's very much the same with all the farmers. We're the only real private enterprise left in this country and we want to remain that way. We cannot operate under the union, with the present union thoughts. So we must eliminate as many people as we can in order to keep the work force down to our steady employees. They are well taken care of as far as compensation for their work in hourly pay, health and accident insurance, life insurance, retirement, and bonuses. Again, I'll brag on my people--we have very little labor turnover. This is the way we want to keep it.

Dickman: Are you looking toward doing harvesting for fresh market tomatoes?

Button: We have worked in this field and are confident we can build a machine to work with the fresh market, green tomato growers. They have a selling problem to solve: if the consumers don't know the difference, they will never be able to tell the difference; but if you tell them it's harvested mechanically, it will make a difference. The buyers are very particular. They are nitpicking on every little thing they can. They don't want to change. They've been doing the same thing for years. They just don't want to adapt themselves to change. We did work close enough with them to find out some of the problems. When you tell them back in New York, Chicago, New Orleans, Florida, or wherever you find these buyers, that they were picked mechanically, something becomes wrong with the tomatoes. There are problems; there's always problems in everything. But the problem has been--other than the buyers--that the tomato is not quite here yet either. You have to stem them by hand, or the stems poke holes in the other tomatoes and decay forms in that area.

But I'm confident the plant breeders will come up with a tomato a lot faster than the buyers will change their ideas. We're ready at the first sign of any cooperation in that area to swing into that field with a machine. We have sold two fresh market machines. One fellow uses it for fresh market and then he converts it to cannery tomatoes. The other one has never been converted. It is an advantage, but it's costly to have the conversion kit; but still, it isn't as costly as owning two harvesters. I believe he was doing it on an experimental basis. So, I think if it ever materialized, they would buy a harvester for the fresh market. We would then work toward a fresh market harvester, and there would be so many more additions to it and changes that it would not be feasible to convert it back to a cannery harvester.

Dickman: Are you thinking about manufacturing any other harvesters for any other crops?

Button: Yes we--The Johnson Company--would like to broaden its field into other areas. I know from conversations with these people that they would like to remain in the agriculture field. This is what we seem to know more about, and are more successful with. We are definitely interested in building other types of harvesters. We've had (I say "we"--it's really the Johnson Company) has had such a phenomenal growth in the last eleven years that it's hard to adapt, it's hard to find people that have the ability to perform all the tasks that are necessary in developing new machines. And successful new machines, I should add, because we have had some failures, as any manufacturer. They're not all successful.

We will, I'm sure, in time to come, build other types of harvesters. However, right now, the biggest thing with the Johnson Company is the tomato harvester. They still build a lot of sleds, a lot of plantivators, AP's--as they call all-purpose cultivators--which is a real aid in mechanization because it shapes and flattens the tomato beds real well and puts on another herbicide at lay-by time. So the recovery of the pickup improves to where you can say that you're picking up 99.9 percent of the tomatoes without picking up dirt. We have worked and developed better methods of cultivation to help our harvester. Growers use this same method on several of the other makes of harvesters. It has helped them also. They still build the almond and walnut harvesting equipment and the cultivators.

Dickman: How about lettuce?

Button: We considered that at one time, but we did not take that project on. If the lettuce harvester is a UC patent, that's one thing: UCD is still considered a land-grant college, I guess. If people's money is running it, it should be people's information. But this is another problem we once got into way, way back. You know, in '61 there were some problems. I got some nasty letters from Blackwelder and the University regarding my harvester. But, somehow we managed to resolve the problems and still go forward for the benefit of the industry.

Dickman: Thank you very much.

ROBERT HARTZELL

Personal Background

Dickman: Mr. Hartzell, how did you get involved in the tomato harvester project?

Hartzell: I graduated from the University of California, Davis, in 1956, in vegetable crops, then I raised tomatoes in Yolo County for Flotill Products and then was drafted into the army. After I got out of the army there was very little money in raising tomatoes, prices being down in the low twenties [per ton]. I interviewed most of the canners in the state and, at that time, Llewellyn Brown, vice-president of Flotill, was feeling the influence of agricultural research advancement. He felt that in the field organization at Flotill there was a need for a separate body to work just with new developments whether they be in pesticides, mechanization, herbicides, quality control, or new methods of handling, such as boxes and bins. When he told me of his concept and his need, I thought that it was an interesting and challenging concept and something that I'd like to try. So I accepted the position of agronomist in the field department for Flotill in January of 1959.

A Historic Mechanical Harvest

At that time the bracero program was an issue; it had been for some time. It was, I believe, in 1959 that Jack [Gordie C.] Hanna and Coby Lorenzen and, I believe, a Czechoslovakian fellow,* had developed a small prototype, a "green bug." They brought it down to Clarksburg and I saw it run on a field of, I believe, Red Top tomatoes that first year. I was impressed with it and its possibilities. It was 1960, I believe, that Les Heringer had a larger model following the same principle, built by Blackwelder,

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*Istvan Janos Szluka

Hartzell: and adapted them so that they'd haul bins--six bins apiece. We could gear down the army truck so that they'd follow the harvester, and we could move them from these various fields we had around the state. So we were pretty mobile.

Bugs in the Machinery

At this time the bracero program was tenuous. Our future was here in California and so Mrs. Lewis and other company management felt that mechanization was the future. We put essentially all our effort and a lot of money into the development of this program. And I don't think I'm being boastful when I say that the company was one of the first to see the profit potential in the coreless, small, mechanically harvested round tomato. Both in the field and within the plant we could see savings. And I have to give the credit for those inplant savings to Arthur Heiser, who was Vice-president of production at Tillie Lewis (he's now President). Llewellyn Brown saw the field potential, Arthur Heiser saw the production potential, and Mrs. Lewis believed in the whole concept.

Dickman: Despite the fact that it came out as ketchup the first time around?

Hartzell: Yes. The labor problem looked critical in 1961. We felt that we had to have machines or we were out of the tomato business. The episode that year with the tomato harvester that we bought was not good, though. Being the first one off the production line, all the bugs showed up in ours. I've got a lot less hair now than I did in 1961, and I'm sure part of that's due to the tremendous problems we had keeping that harvester running. I could never seem to go to lunch and come back and have the thing running. Blackwelder took that machine back in after we finished with it, and ran it, day and night, up on blocks in their shop to try to find the weak points. We donated it for that cause and they ran it and ran it and brought it up to specifications for the 1962 season, when we again ran it. It was materially improved, but by that time there was a resurgence of the bracero program. This was one of the quirks of the time. Congress made some moves and it looked like braceros were coming back, and the whole program kind of died a little.

Dickman: --the whole mechanized harvesting program?

Hartzell: Yes, in 1962 there were very few of the harvesters that were run to any extent, and maybe a little more in 1963; and then, as I recall, around 1964 it was inevitable that the bracero program would terminate. By that time Blackwelder improved the machine, FMC and [Robert Lesley] Button had come into it, and the activity

Hartzell: and interest increased. It gave a breather to make some improvements before we came up against a critical situation.

We haven't talked about two episodes that I think need to be discussed. In early 1960 we needed to get an early trial on that first harvester, so we had a field grown at Mellowland, which is by El Centro. And those tomatoes came on, as I recall, in June--at least before we had them up here--so we could get a try with the harvester. The harvester was hauled all the way down and run for a very, very short time; and it broke. It seemed like it was 110 degrees outside. Blackwelder had to get parts flown in. And so we sat around waiting for the parts. When they got there we teamed up into shifts--three or four of us to a shift--because we had to completely tear down a rather complicated pickup chain. And there was Hanna with a monkey wrench and me with a monkey wrench and Coby with a monkey wrench and Ernie with a monkey wrench, and all the plant breeders. I don't care if you were a cannery man or a plant breeder; you were a mechanic, and we worked around the clock, in shifts, getting that tomato harvester operating. It was always nice to work in the evening shift because it was a lot cooler. That was the first running. Really, you could say that was the first field operation of the larger harvester.

Dickman: Who acted as sorters after you got it running?

Hartzell: We all did. I remember we had so much trouble getting tomatoes that we couldn't fill a bin. So we took a bin and put a plywood false bottom just below the top so we could get just about that many tomatoes in it and it would look full. And then we took pictures of that (laughter).

In 1966--to show you how much the company believed in this program--Tillie Lewis bought thirty tomato harvesters. It was the biggest single order that Blackwelder ever put out, I believe. And, I'm accurate in saying, eight years later, that those thirty machines are still owned by the company and they're still operating. So it was a good investment. Now, as I recall, at that time we paid about twenty-three to twenty-five thousand dollars apiece for those machines.

Using the First Tomato Successfully Bred for Mechanical Harvesting

Another episode, of course, is Jack Hanna's [VF] 145. After that episode with 206--with Dave Wilson--I believe it was the next year that Jack had the 145 which he thought would be suitable. And since Flotill had been a kind of a pioneer in this whole effort he allowed us to have some seed. We sent the seed to Mexico and had it increased by, I believe, Peto Seed Company. We brought the

Hartzell: seed up and planted it out in a field south of Tracy with "Doc" Westbrook. It was the first 145-B to be planted. The crop was absolutely fantastic. We got those tomatoes in the cannery and and they were just like little red golf balls; they were just beautiful. That sold management on 145.

We got Ferry-Morse Seed Company to make seed out of that, which we didn't put through the cannery. "Doc" Westbrook was extremely excited about it because the tonnages were significantly higher than you'd normally expect. We took that harvested seed and had it grown out around the state the next year. Until the tomato harvesters came into greater use, we were growing 145s and cutting the vines and then hand shaking them and then picking the tomatoes up off the ground. This was because they were so much better in the cannery. This was a big break, I'm sure, in the development of 145.

Processing Tomatoes in National Perspective

Dickman: You were talking about the fears of losing hand labor in 1961. Your cannery had never thought of moving away, but turned to mechanization to solve the labor problem. Were there other canneries from your own knowledge, that were actually thinking of moving?

Hartzell: Well, there was a lot of press about it. Tri-Valley Growers talked about it. Heinz already had a plant in Mexico; Cal-Pak (Del Monte now) has a plant in Mexico. I guess those intentions were real. I believe Tri-Valley even had a rather extensive feasibility study done. Some of it, I'm sure, was the politics of lobbying for a program such as the bracero program--trying to keep it and saying that, if we can't have it, we're going to move. I'm sure there was some of that going on. That seems to be the way we fight fires.

Dickman: Is it your opinion that the fact that there was a mechanical harvester saved the tomato processing industry in California?

Hartzell: Oh, no question about it. It kept the industry here in the state. I remember going back to a national conference on mechanization, I believe it was '66 at Purdue. We had this really remarkable success story here in California. But, the eastern producing areas--at that time they were about forty percent of the industry, outside of California--were feeling the threat of our mechanization because we were producing and processing tomatoes cheaper here. All parties in the United States who were interested in this got together at this conference and discussed what we had done and took a look at whether our system was adaptable to Ohio, Indiana, New Jersey, and some of the other production states. I came back with the

Hartzell: definite opinion that the odds were against it being successful back there.

Dickman: Why were the odds against them?

Hartzell: They had too many uncertainties of weather. We can control moisture here. We have a dry fall. We have a longer growing season. They are not set up for irrigation. They cannot direct seed--to me that's a must. Those are probably the two biggest single things: they cannot direct seed tomatoes and have to depend on transplants; and they don't have absolute control over their irrigation. It rains at times when you shouldn't have rain. I remember making that projection to our sales department, and I'm kind of pleased that it did turn out to be accurate. Mechanization certainly hasn't gone any place in the eastern part of the United States.

Dickman: I understand that California is now providing nearly 100 percent of the canning tomatoes. Is that correct?

Hartzell: No, a little over 80 percent.

Dickman: But at the time we're talking about it was only providing 60 percent? So it's gone up--

Hartzell: It's gone up about 20 percent. And it's going to go higher. It's going to go above 80, we may get up to 85 or 88 percent. I question whether any single processor would ever put all of its processing tomato "eggs" into one state. You have got to spread your risks out. And there's a lot of investment in plant and equipment back there. Not in the forseeable future will they allow that to go dormant.

Plant Breeder Nonpareil: Jack Hanna

We were talking earlier about the amount of cooperation that existed between the canners, the growers involved, and the University, the equipment manufacturers, and the chemical manufacturers. It really took a combination of all these talents to make the system work. There's no question in my mind that the two key people in this were Jack Hanna and Coby Lorenzen. I had more contact with Jack than I had with Coby. Jack was very much a stabilizing influence. He's an extremely good listener. Jack also has the ability to think very, very far ahead. He sifts all the day-to-day chaff out and hits the kernels of wheat very easily. I'll give you a couple of examples.

I recall Jack talking about the eating habits of people and why people like tomatoes. As you know, the per capita consumption of tomatoes has been going up dramatically. He pointed out that

Hartzell: we tend to eat potatoes and rice in large quantity. We can eat two helpings if we want to and still want more. On the other hand, you take a freestone peach and a cling peach. Freestone peach is highly flavored. Cling peach is not so highly flavored. You'll eat more cling peaches than you will freestone peaches. The first taste of freestone is better, but your taste buds become saturated rapidly because of the high flavor. The same is true of tomatoes. Tomatoes are not a highly flavored product. They are modestly flavored. Therefore, we eat more of a modestly flavored thing, in total pounds, than we will of something that's highly flavored, where we want one mouthful and maybe two, but after we've had maybe three or four, we don't want too much more. Hanna observed this and I think he's absolutely right.

He also looked ahead to what young people are eating. He was very taken by the statistics that show that, lets say, half the people in the world are under twenty. You've seen those statistics. I don't know if that is accurate, but it's something like that. And he says, "Well, let's look at what those people under twenty are being exposed to. Because, from a plant breeder's standpoint, I have to breed for what those people are going to want to eat. And what are they eating? They are eating a lot of french fries and hamburgers, and what are they putting on french fries and hamburgers? Ketchup. And, they're being introduced to pizza, and what's the basic ingredient of pizza? It's tomatoes. So he has a tremendous ability to look at the future and say, "That's what people of the future are going to be eating and that's the food that I'm breeding today." Tremendous ability there.

Dickman: You were talking about the cooperation between these people.

Hartzell: Oh, yes. Everyone came to Jack and to Coby for counsel, to try ideas out, to think things through. Jack's a great one to think things through with. We were all coming to a central point, Coby and Jack, for advice. And so, although we really didn't know it, we were coordinating ourselves because we were all talking to the same two guys. We all had a common goal, and when people have a common goal, they do come together. We were seeing a lot of that. You had the believers and the nonbelievers, but all that made good discussion, gave you something immediately in common to talk about. The cooperation was very strong. It's a hard act to follow, as I've said many times.

Dickman: The nonbelievers--apparently a lot of them were in the veg crop department?

Hartzell: Well, Jack is a nonconformist in the University system, and the University has these rules about publishing. But Jack's a doer; he's not a publisher. He'd much rather be doing something with his hands in the field than writing a manuscript. Jack doesn't like rules.

Hartzell: (I don't know if you've run into his weird sleeping habits, but Jack gets up about two o'clock in the morning; he'd go out to the greenhouses and he'd work in his greenhouses until sunup then he'd go out in the field. And then he'd come in and have breakfast. Then he'd go to his office, until noon. And then he'd go home at noon and take a long nap, and then come back to the office until time to come home, and then he'd eat. But, by seven-thirty or eight o'clock, Jack's in bed. And then he'd get up at two o'clock.)

Anyway, Jack's publication record was never anything to brag about. He wasn't writing much. And all these other guys in his department were saying, "How can you give him that recognition when he doesn't write anything?" Well, Jack says, "I'm not gonna write anything." And he was stubborn. "I'm not going to write anything. I'm going out and do it." Well, he was a renegade. In his own department. But his accomplishments were so great that the department could not fail to recognize his achievements--probably far and above anybody else in that whole department, more than anybody else. He was a doer, and Jack has no place for guys that aren't doers. The drones have no place in Jack's life.

GENE WINTERS

Winters: We used to farm here. My dad and I were partners years ago, to about 1957, I guess. But we started growing tomatoes here about 1941, I think.

Dickman: How many acres of tomatoes did you average in those years?

Winters: Probably around three hundred. Sometimes, we'd have five hundred or six hundred, sometimes a little less. But around three hundred acres.

The Blackwelder Harvester

Dickman: Do you remember the first mechanical harvester that you saw at work?

Winters: Yes, I think [Bernell] Harlan* had one working down here. I don't remember--in '62, '63, I kind of began to look at them. When they first came out, the banks--they didn't think much of them. It looked like a lot of money to finance one of those. And, gee, they were scared. They finally got talked into it, and after they tried it, they were all for it.

Dickman: What was the first harvester that you bought?

Winters: The first one I got was a Blackwelder, in '65. And we're still running it. We run Blackwelders. We remodelled them. They're quite a bit different machine than they were when we first bought them. But we're still running them.

Dickman: How many do you have altogether?

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*A prominent farmer in Woodland, California.

Winters: We've got two. Both Blackwelders. The other is a '66. One of them's run nine years, and one's run ten.

Dickman: Did you have any difficulties with the machine at first?

Winters: Very little. We run into some tight times where we get a little bit of trouble, but as a rule we don't have very much trouble.

Dickman: When do you think you'll get one of the new ones with the electric sensor, electric sorting?

Winters: Probably next year.

Dickman: Really? I understand they cost a hundred thousand dollars.

Winters: I've been afraid to ask what they are going to cost. They are putting some electric eyes on some of these old machines. They have a kit that goes right on the back of the sorting belts.

Dickman: Will it do away with most of the sorters, or all of the sorters? How is that going to work?

Winters: I don't really know just how many it'll do away with, but it'll do away with quite a few.

Dickman: Somebody's got to take out the dirt clods, I suppose?

Winters: Well, we're working on one machine here--playing with it a little bit now--fixing the dirt belt in it to take a lot of the dirt out. And if we can get the dirt out and if we can get all the green out, you aren't going to have near as many tomatoes to sort.

New Tomato Varieties

Dickman: How about the change in tomato culture--the change in growing them?

Winters: It was quite a little difference. The first year we tried to grow them, we had pretty much of a flop. We just didn't do it right. And, after that, why, we figured out how to grow these things. They grow pretty much the same as the old ones used to.

Dickman: Were you using the VF 145s the first year?

Winters: Right. And we just didn't fertilize them enough. We didn't treat them quite right. A good share of fellows started in and they hit it pretty good the first year. First we looked at those guys and they did all right and that's the way to do it.

Dickman: Are you still using the VF 145?

Winters: Yes, we're still using the 145 (78, 79 variety).

Dickman: Is that a little bit more square than the original?

Winters: No, I don't think so. That square one hasn't come out very much yet. We grow some of the ones they call the baloney. They're a long tomato. But primarily I like the 78, 79 the best. Every once in a while the cannery takes notion they want some of the others, and we have to plant some of them, and we do. They're a good tomato. I imagine in the near future we're going to get this square tomato. Well, it's not square, but it's not round either.

Dickman: What will be the big advantage of that? Will it transport easier?

Winters: They say it won't break near as bad. It'll stand a little rougher handling.

Dickman: What percentage are you leaving in the field?

Winters: That's a hard question to answer. Sometimes we don't leave any to speak of. And other times you will leave quite a few tomatoes. And those 65s, which are the baloneys--we lose more of them than we do anything else. They seem to shake off quicker and drop through more than the others.

Canneries and Mechanical Harvesting

Dickman: When you first used the harvester, what cannery were you taking your tomatoes to?

Winters: We were taking them to Contadina and Libby the first year we had it.

Dickman: The canneries--did they take to the harvester, to the mechanical harvest?

Winters: Yes. The canneries, they liked it. And they--Contadina has, and most of the rest of them--have tried to schedule their plantings and their growers. When this stuff's ready, why, they're able to take it. This year's going to be a little tricky, because all this early stuff didn't make and it's all going to come in a shorter season.

Jack Hanna: Mr. Tomato

Dickman: Did the farm advisor help out in the early days?

Winters: Yes, the farm advisor and the University--they helped out a great deal. Old Doc [G. C. "Jack"] Hanna here, he's the man that's Mister Tomato. If it hadn't been for him and some of the rest of them

Winters: learning the development on these varieties, and one thing and another, no way could we have harvested the old handpicked tomatoes with these machines.

Dickman: Did you know that Jack was working on this compatible tomato way back in the forties and fifties?

Winters: Yes, we knew he was working on it.

Dickman: What did you think of his chances?

Winters: Well, we had figured that eventually they'd make it and get one. He put in a good many years at it before he got something that was right. And he's still working on it today.

Dickman: How many tons an acre were you getting back in the forties and fifties?

Winters: I don't remember just what the state average was, but I think around fifteen or sixteen tons to the acre. We figured if we had a twenty-ton crop, that was a pretty good crop.

Dickman: And what's it averaging now?

Winters: I think last year they averaged statewide twenty-three, twenty-four tons.

Dickman: Is that about what you get, too? Or do you beat the state average?

Winters: We usually beat it a little bit. Oh, we grow stuff that quite often will make thirty, thirty-five tons.

Solving the Labor Problem

Dickman: Well, from 1941 to the present days of mechanized harvesting, you must have used a lot of different kinds of labor?

Winters: Yes, we've used a lot of them. We've used everything from winos to wetbacks, Mexican nationals, Navajo Indians. We brought the first of them here in about '42, during the war. Labor was pretty hard to come by. The Spreckels Sugar Company brought a few Navajos in here to try them as a beet crew, and they worked fairly well. So we went down and recruited a bunch and brought them in for the tomato deal.

Dickman: Where did you get them?

Winters: Most of the ones we got came from out around Windowrock and Fort

Winters: Defiance country, Arizona. We'd haul them out of Gallup. We took the old Weston-Curson school buses from here down there and hauled them back.

Dickman: All male, or did you bring their womenfolk?

Winters: No, we brought women, kids, the whole works. Just the men weren't much good. But if you brought the old squaw along, why, she and the kids would work. The man--he'd start getting ready to go to town about Thursday or Friday, and then he didn't feel like going to work till Tuesday or Wednesday again, most of the time. Some of them were pretty good, pretty steady, but if you brought a bunch of the good, husky young bucks, why, you just didn't get much work out of them at all. They were too busy living it up.

Dickman: Where did you put them up?

Winters: We camped them out in tents mostly. You'd give them a good tent and straw pallets. We put some in the camp. And we had a good camp down on the creek. They'd just take the beds and pile them up in the corner and sleep on the floor anyway. They liked this camping business. Give each family a tent, a good-sized tent, and they were used to living in it that way. That just suited them fine. Of course, the camp inspectors didn't like it too well. But they finally got educated to it. And we did it for quite a few years. I think '51 or '52 was the last of them.

And we started getting the Mexican nationals in then. When they came, they really came to work. They were just much better help. It didn't take near as many of them to do the job as it did the Indians.

Dickman: Did you have any trouble with the Indians at all?

Winters: No. No serious trouble. They'd all get drunk on Saturday night. I'd take the bad ones in and throw them in the pokey and go bail them out Monday morning (laughter) again.

Dickman: Well, then you were using wetbacks and then the wetback program went out the window?

Winters: No, not wetbacks--nationals.

Dickman: Oh, was it bracero?

Winters: The bracero program. Wetbacks--they were illegal. If you had a bunch of them, why, sometimes the immigration people would come along--border patrol--you didn't have any at all. Didn't take them too long to get back, though. In a few days, they'd be back again.

Winters: The national program or the bracero program--it was a good program. We had to put up with all the government's red tape and ballyhoo on it, but we got the work done. And then when they closed the bracero deal down; I guess '64 was the last year we had some. We had trouble getting them then, and we figured we were in pretty bad trouble on this tomato business.

But they really did us a favor when they made us go the mechanical harvest, because it's just so much easier and simpler than fooling with the other. As long as we were able to get those braceros, if we were able to get them, we just wouldn't have got pushed into this mechanical harvest near as quick as we did.

Dickman: When the braceros were phased out did you say you then used winos?

Winters: No. Oh, some people did a year or two afterwards here. They tried to use winos or whatever they could get. But it was pretty much of a flop because they just can't do the job.

Dickman: Did anybody train them? There was a program over at Davis, I think. Do you know anything about that?

Winters: Yes. I think that was about as big a farce as most of our government programs are (laughter). Those guys, they went to school down there for--I forget what it was--three or four weeks. They got paid for going to school. And after they graduated, you didn't get 10 percent of them that went to pick tomatoes. All they were after was the free pay and the school.

Dickman: How many are in your crew now on the two harvesters?

Winters: It all depends on the fruit. If it's pretty good stuff, we run ten or twelve, up to fourteen, fifteen per machine.

Dickman: Do you get the same people each year?

Winters: Pretty much.

Dickman: Local people? High school or college kids?

Winters: Well, mostly they're older people. We work some kids. But if you get too many kids, then when school starts, why, you lose them and everybody else is losing theirs. And you have trouble finding a crew. So we try to keep a pretty fair nucleus of a crew that's going to be here the whole season. The kids are fine. They're good sorters: they're quick. In our crew we have irrigators and their wives and families, and we have certain people that come from Sacramento year after year. The same people.

Dickman: Thank you very much.

JOHN T. MILLER

Dickman: Please tell me what you do now and what you did back in the early sixties.

Miller: Okay. I'm John T. Miller. I'm chief of the [State] Department's [of Agriculture] egg and poultry quality program. For the past year I was the special assistant in the Division of Measurement Standards. Prior to that I was the special assistant in the Division of Inspection Services. In that division we had basically five functions: our fruit and vegetable inspection program, shipping point inspection program, chemistry--ag chem and feed--chemistry lab, grain inspection program and our egg inspection program. Prior to moving to the division, I had been chief of the Bureau of Fruit and Vegetable Standardization which at that time consisted of the egg inspection program, fresh fruit and vegetable standardization program which included the canning tomato inspection program. The latter was placed in this bureau back in 1941 at the request of the industry--both canners and growers.

Prior to 1941 the canning tomato inspection program was contained in a rather loosely written law that was unsatisfactory to both growers and processors. I was not involved in the inspection during that period of time but both the growers and the canners complained that the inspection program gave neither of them the results that they desired. The main complaint of the growers was that during a glut of the deliveries of tomatoes for processing, even though a load was suitable for canning, the processors would return the load to the growers; this action created a rather bad feeling between the processors and growers at that particular time.

In 1941 both the growers and processors went to the legislature and requested a processing tomato law. They hammered out the various tolerances and agreements as to how the canning tomato inspection program should operate and the law became effective on August 15, 1941. The same day the law went into effect, the first deliveries of canning tomatoes for that year were being received at the canneries.

Miller: Prior to the time the advisory committee was created, we would meet with the processors and get their viewpoints and then we would meet with the growers and get their viewpoints. Both sides needed us for guidance and consultation as to what was feasible and then we had to make damn sure we kept our mouths shut so we didn't breathe to either side what the other side had said. Now everything is above board on the table and good frank discussions develop.

Dickman: Was that before the days of marketing orders?

Miller: Well, there were some marketing orders in other phases of agriculture. As an example, the asparagus people had a marketing order for inspection that went out about the same time and it was the beginning phase of the marketing orders and since then there have been others.

Those initial years when they used strictly boxes: I think one of our biggest problems was the sampling of loads of tomatoes--getting the boxes out where they could be sampled and they would vary all the way from a pickup load to a large truck-trailer load. These individual fifty-pound boxes on the load would shift while they were being transported and, of course, we had to sometimes go to the bottom of the load to make sure they weren't stacking--being stacked with the poor fruit on the bottom which was a common occurrence in those days. And it was real trying at stations sometimes to get the truck driver to get the bottom boxes out. Because of the shifting of the boxes they were overlapped and the truck drivers would literally have to tear the boxes out in pieces to get at the tomatoes. And there were some pretty hairy episodes that took place. We were threatened to get knocked off the platform a few times but we had to carry out our duties.

Dickman: What have been the major effects of state inspection on the transportation of processing tomatoes?

Miller: The main effect in the processing of tomato inspection was in the advent of the so-called bin instead of the lug box and the switch from boxes to bins and now to bulk tanks. When we switched from boxes to bins we immediately had a problem of determining how to sample a bin and who was going to furnish the mechanism for arranging the sampling equipment. And we went to the University and the University developed the initial sampler for sampling bins of tomatoes.

Dickman: And that was the ag engineering department at UC Davis and Professor Mike O'Brien?

Miller: Right. This was when we submerged a bin of tomatoes in a tank of water and had the so-called tube down in the submersed tomatoes

Miller: and pulled out the sample. And the first year the industry and the growers used money out of the inspection fund to finance the purchasing of this sampling equipment and the University did further development on it and we got out of the so-called water tanks and into the present method of sampling with the cutting edges from the bulk tanks. When we switched from the wet sampling to the dry sampling the department insisted that the business of purchasing sampling equipment was not the department's responsibility; so now the station operator, whether it be the canner, or an individual or the trucking company, must furnish the sampling equipment.

Dickman: I see.

Miller: This meant that we got out of the wet sampling business so we had a tremendous supply of wet samplers and tanks and pumps and stuff to unload. The department sold all of those and now we are strictly in the inspection business.

Dickman: In addition to the physical changes in sampling, were there any changes in the grade requirement?

Miller: The grade requirement changes were mainly in the developing of the color standards. Instead of cutting the tomato in half and visually observing the color on the tomato they now have the comminuted sample where we grind up a sample of tomatoes and determine the color of the load of tomatoes by the juice and we still use the agtron for this. The agtron was converted to a color machine on cut halves as well to determine the color in the juice. The juice color gives a true representation of the actual color of the entire load of tomatoes and apparently has proven very satisfactory to the industry. The rejection factor for under-colored tomatoes has decreased considerably.

Dickman: Has the allowable maximum percentages in each grade category been changed?

Miller: They have been changed somewhat. Initially, the law permitted a full 10 percent for worms and mold. This has been amended; now it specifies a maximum percentage of 8 percent for mold tolerance and the worm tolerance is 2 percent.

Dickman: As a neutral observer what is your opinion about the effectiveness of the present-day samplers?

Miller: I think it is the finest method that can be developed. I know when the University worked on the problem they worked on a vacuum system which all of us had high hopes for at one time. But due to the

Miller: compactness of the tomatoes in the load coming from the field to the inspection station and the mature conditions of the tomatoes, the vacuum just bruised and beat up the sample to the point where we couldn't use it as a grade factor. This is the reason why they have the present method of the tube with the cutting edge which was an adaptation of the technique used in the sampling of grapes going to the vintners for wine purposes. I know we've looked at many different ideas and I've had many discussions with Mike O'Brien on it. He's done just a tremendous, outstanding job for the industry developing this.

Dickman: Are there any central sorting stations in use?

Miller: Yes. There are central sorting stations in use; however, they are primarily being used for a different purpose than originally intended. When the so-called central sorting stations were initially developed, the theory was that the mechanical harvester with practically no sorters would go through the field and all the tomatoes that were on the vine were brought in. The tomatoes were put through a central sort where the sorters on the belts would pull out the bad tomatoes. There were many problems with having all these rejects in one central location instead of out in the field where they could be scattered. Water was a problem. Dirt was a problem. And soon it reverted back to doing the sorting on the harvester. The central sort stations which are still in operation are mainly used today for the re-sorting of rejected loads. A bulk load of tomatoes now would just be practically an impossible task to recondition without a central sort operation. There is just no way you can put fifty people to work sorting out a bulk load of tomatoes. There is no place to stand, no place to work, no place to do anything. So the central sorts do meet a need and I think that they will remain. The way the price of processed tomatoes has been going, it's just too valuable to take the load out and dump it.

Dickman: What percentages of tomatoes are not accepted?

Miller: It varies. I think the highest percentage of the loads of tomatoes that were rejected in a given year was about 3 percent. This varies with the climatic conditions during the growing season and if my memory is correct, I believe in the last few years we have been down between 1 and 2 percent.

Dickman: What was it back in the forties with hand harvest?

Miller: Well, it was considerably higher. Like I said, we were up at 3 1/2 or something like that and there may have been a '41 and '42 year period when we first started that we may have been up around 5 percent. At that time we had more rejections for loads that we found

Miller: to be deceptively loaded with the poorest quality in the bottom of the load and the good fruit stacked around it. But with the bulk-type tanks used today it's very difficult to so-call "stack a load."

When we first started on the bulk tanks we did encounter some stacking because at that time the mechanical sampler was not perfected and they used little portholes to pull our samples out of these big tanks. One day we were out in the field, and we were watching this man standing in the tank while they were loading it; we noticed that every time he got near a porthole he started sorting tomatoes madly and when he got away from a porthole everything went in. So we then had to observe some fields and watch the operations to make sure there were no deceptively loaded loads.

Dickman: What will be the effect of the electronic sorting equipment now in use on some of the harvesters?

Miller: It's going to be an interesting process to see just how accurate this is going to be. It should be a tremendous labor saver and should, if it works properly, give a more uniform grade. There may have to be adjustments in the grades in some areas. We've seen electronic sorting used on lemons, as an example, where people demand a real uniform color on lemons and it's been highly successful in the lemon industry. We've seen the electronic type sorting in egg packing plants where they use the electronic eye to eliminate the eggs containing blood, which is an internal defect. It does a satisfactory job on the blood eggs so I see no reason why it can't work on tomatoes. What effect it's going to have on the inspection program remains to be seen because there are conditions that can happen to the load after it leaves the mechanical harvester. There still will be some necessity for inspection, I'm sure, because I'm sure the electronic sorters can be adjusted to what grade they want. And there probably have to be some controls over this.

Dickman: What's the relationship between the inspection for market and processing tomatoes?

Miller: Actually there are two separate operations. We use different inspection, different inspectors and there are different grades. And, as an example, in our fresh market grade, we have no minimal color for tomatoes like they do in processing. Actually the processing grades are more rigid in some respects than for fresh consumption which is surprising.

Dickman: I wonder why?

Miller: Well, mainly in the color area; a tomato that is picked when it

Miller: reaches that point in maturity where it will complete its ripening process after being removed from the vine will continue to get red. They have to ship them to the terminal market and out to the retail store, and during this time interval the tomato is continually getting redder. If it was picked too ripe to begin with, by the time it got to the consumer it would be mush. But in the method of handling processing tomatoes today, many of the loads are processed the same day that they are picked so they have to have this color. The other factors are fairly comparable, so actually, an overall comparison of the grade of tomatoes between the fresh and the processed shows the processed tomato is a higher grade than the tomato being sold for market consumption.

Dickman: With all of the controversy over taste, do you expect that the inspection will ever add that as a requirement?

Miller: I have reservations about that. I just have reservations about taste.

Dickman: What do you think about the recent news stories on the square tomato?

Miller: Well, it just happened to come out that way (laughter) and whether it's square or round, the consumer is the one that's going to determine whether or not they like the flavor. If we made it oblong like the banana and the flavor was there, the consumer would still buy it and once its ground up and put into sauce or catsup or paste or puree, the flavor is the main thing. Of course, in the solid-pack whole tomatoes, somebody might like a square one for a conversation piece. A tomato is still a staple food and apparently it is being developed more and more worldwide. There are many contracts being considered at the present time for development of tomato processing in many foreign countries. In fact, last year I had the opportunity to work for a food machinery corporation which is doing much of this developing in other countries; I took six weeks vacation from the state and went to work for the Food Machinery Company as a consultant to set up an inspection program of tomatoes in Bulgaria. If the California people could see the methods that have been used in processing and growing and handling of tomatoes in Bulgaria, they would shudder. The inspection methods were more primitive when I got there than we were in 1941.

Dickman: They tell me that Bulgaria is about as progressive agriculturally as any of the countries behind the Iron Curtain.

Miller: They are trying. Last year they bought five FMC harvesters. They are in the process of setting up a contract for a modern processing plant. But without being too critical of those people over there,

Miller: they are trying to set up a food program because they recognize that there is eventually going to be a shortage of food. But before they get too far off the ground, they are going to have to do something to create an incentive for the people. And I did learn over there that the U.S.A. is a wonderful country to live in!

In summarizing the canning tomato inspection program in California: it began in 1941 when approximately 500 thousand tons were inspected; the present season approximately 7 million tons are being inspected. The inspection program had to have the full cooperation of both the processors and the producers in order to maintain a good, sound, efficient type of inspection. It took teamwork between the three groups, the processors, the producers and the inspection agency. During these past forty years there appeared to be problems which were insurmountable, but through teamwork all were solved. There were periods when growers attempted to block deliveries of tomatoes to processors in protest of too restrictive inspection. There were periods of time when the processors were critical of the inspection service because they wanted tomatoes which we would not pass. Threats were made on individual inspectors, bribes were offered to individual inspectors and in some cases enforcement officers were called to the scenes. A classic example was when a group of truck drivers protested the inspection procedures and let the air out of all four tires of our state supervisor's automobile and stuffed tomatoes in his automobile gas tank. It has now been a considerable period of time since episodes such as that took place and I believe those days are basically over with and that a successful inspection program will continue.

Dickman: Thank you very much.

RAYMOND F. ROTH

Dickman: Would you identify yourself, please, Mr. Roth.

Roth: I am Raymond Roth, presently with the state Department of Employment Development.

Dickman: What were your responsibilities in the early 1960s?

Roth: Our present department at that time was known as the Department of Employment. During the sixties, I was the administrator of the Farm Labor Service within the department.

Dickman: And in that position you were responsible for carrying out the so-called bracero program?

Effects of the Bracero Program

Roth: We played a very important part in the certification and in the authorization of the importation of those foreign workers.

Dickman: I note now, for the record, that you have prepared some basic questions and have written the answers to those questions in preparation for this interview. So the questions that I am going to ask, and the answers that you will give, are those which you have prepared?

Roth: That is correct.

Dickman: The first question: At one time the harvest of canning tomatoes was one of the heaviest labor-using crops in California. It was also, at one time, one of the heaviest users of imported foreign labor. Can you, therefore, give a historical overview of what is commonly referred to as the "bracero program?"

Roth: Large-scale, intensified and diversified farming--which were destined to become the dominant characteristics of California

HANDPICKING TOMATOES IN THE 1940'S

Roth: agriculture--began to emerge a little over one hundred years ago. With this emergence came an early dependence on foreign labor. First, it was the Chinese: some who were being driven from the mines and others who were released due to the completion of the transcontinental railroad. They were followed by East Indians, Armenians, and others.

During and after World War I, huge numbers of Mexican aliens migrated into the state to work in agriculture, many of them entering the country illegally. They were followed by waves of Filipinos and in the thirties by the great American migration from the stricken Dust Bowl area of the Southwest.

With the onset of World War II came a clamorous demand for Mexican labor such as occurred during World War I. In an effort to control massive, illegal border crossing and to provide at least some minimal protection to those aliens who entered the country legally, as well as to our own citizen workers, Congress enacted special legislation authorizing the importation of workers from Mexico as temporary and supplemental workers for agriculture. When this specified period of employment was completed the workers were returned to their homes in Mexico.

Under this arrangement a peak number of sixty-two thousand workers were imported in 1944. This arrangement continued through 1948, when the wartime legislation expired. Although a trickle of importation continued under the eighth proviso of the Immigration Act of 1917, it was not until Public Law 78 was passed in 1951 that significant importation was resumed.

As originally enacted, this law was to be operative for only a two-year period. However, in the years that followed it was successively extended for additional two-year periods through 1963, when it was extended for one year (through 1964) and then allowed to expire.

Dickman: Prior to the availability of the bracero, how would you describe the canning tomato harvest work force here in California?

Roth: The work force employed in the canning tomato harvest prior to the utilization of contract Mexican nationals consisted of three principal segments. The first segment was composed of a sizeable number of local workers whose permanent residences were in the cities, towns, and rural settlements in or near the tomato producing areas. Men, women, and older children were all well represented in this group.

The second segment consisted of migrant workers, including those who historically moved about within the state participating in the various fruit and vegetable harvests, and also including, of course, those workers and their families who migrated into the

Roth: state from the south central and southwest states. Citizen Mexican-American workers were well represented in both of these groups.

The third segment consisted of those workers, largely members of racial minority groups, who temporarily left the large metropolitan areas to come into the Central Valley solely for participating in the tomato harvest. Black workers and their families, for the most part, dominated this segment.

Diffused throughout the latter two segments were an elusive and indeterminate number of "wetbacks", the illegal aliens who had entered the state from Mexico.

For as long as their numbers were equal to the demand, this was an adequate and productive work force. The constant expansion of the canning tomato acreage which took place year after year in the fifties contributed to an imbalance between the supply and demand of hand harvesters that compelled turning attention to the utilization of contract foreign workers. The Korean War and the expansion of nonagricultural jobs in the early fifties were also contributing factors.

Dickman: When did the use of braceros reach its peak in California with respect to the canning tomato harvest?

Roth: Substantial numbers of contract foreign workers from Mexico were not used in the canning tomato harvest in California until 1952. The use of contract foreign workers steadily increased through the middle fifties, with much of this increase directly related to the mounting labor demands for the canning tomato harvest.

Importation of workers under Public Law 78 reached its peak in California in 1956. In that year, annual employment of foreign workers for all of agriculture within the state averaged slightly less than 50,000. In that year, too, employment of foreign workers ranged from a low of 26,500 in mid-January to a little more than 100,000 about the first of October. Fifty thousand, or approximately one-half of this peak, were employed in the canning tomato harvest.

Its Decline and Termination

Dickman: What can you say about the decline and ultimate demise of the bracero or foreign contract labor program?

Roth: The demise of Public Law 78, plus the stringent criteria that had to be met before importation under the immigration law (Public Law 414) could be considered, brought dire predictions of disaster and

Roth: doom from agricultural spokesmen, particularly from the canning tomato industry. Included among these predictions there were many gloomy forecasts that termination of the bracero program would drive the tomato industry out of the state, principally to Mexico because of the heavy dependence of California tomato growers on Mexican braceros at the time of harvest.

The truth is that although the tomato acreage in the state declined from 143,000 acres in 1964 to 123,000 in 1965, it again soared to an estimated 156,000 acres in 1966 and continued to climb during practically each succeeding year. Preliminary estimates of the present canning tomato acreage in California for the current year, 1975, approached the 290,000-acre figure. There is little doubt that such advancement of the important and profitable tomato crop could not have occurred under the constraints of the foreign labor program.

Dickman: Now, this is a question which has not been prepared, and which you may or may not be able to answer. You have pointed out that although the bracero program was intended to be temporary, it was extended and extended. I assume these extensions came about as a result of pressure--political and otherwise--supporting its continuation. Nonetheless, it was terminated by Congress (with the vigorous support of the Department of Labor) in 1964. Now, I'm wondering, did the knowledge of imminent availability of the mechanical tomato harvester influence this termination?

Roth: I'm sure it was a factor and a very important one. And in addition to that, of course, was the mounting controversy that accompanied each successive extension of the law. When that controversy reached such a point of intensity and the prototypes of the tomato-picking machine were being tested, I am sure that the prospect of further and final development of the mechanical harvesting operation did have an effect on the termination of the law.

Dickman: Resuming the asking of your prepared questions: what was the impact of the termination of the contract foreign labor program on the California canning tomato industry as a whole?

Roth: Following the 1956-57 peak period, the utilization of foreign workers in all of California agriculture began to subside, but ever so gradually. Notwithstanding this gradual decline, the canning tomato industry continued to depend heavily on the availability of braceros to meet harvesting labor needs.

In the early sixties, however, the termination of their availability began to loom more and more as an eventual possibility. In 1962, the first prototypes of mechanical harvesters began to appear. But it was not until 1965, the first year following the termination of Public Law 78, that machine harvesters were utilized to any significant extent. In that year, 1965, about twenty-five

Roth: percent of the canning tomato crop was harvested by machine. In 1966, this rose to about 66 percent; in '67, to 80 percent; and in 1968 to over 90 percent. By the early seventies all but a fractional percentage of the canning tomato crop produced in California was being harvested by machines.

Dickman: What impact did this mechanization have on the work force that had been required to harvest the canning tomato crop in California?

Roth: This mechanization, to say the least, had a dramatic impact on the work force requirements for the canning tomato harvest. Not only did it reduce the number of field workers required, but more importantly it substantially altered the type of worker for which the tomato harvesting activities were then most suitable.

The operation of tomato harvesting equipment entailed the use of workers principally in three occupations: the harvester operators, the tomato sorters, and the sorter supervisor. The skills required, although akin to those of other agricultural work, had certain unique features. These presented no great problem, as growers soon began conducting on the farm, just prior to the onset of their harvest, the necessary training of these workers.

In numbers, the far greatest need was for sorters to work on the machines or at central sorting sites. This work was particularly suitable for women and youth who, at the outset and now, continued to dominate the group. They were for the most part eager, dependable, and efficient workers who could usually be recruited locally. The blood, sweat, and tears that had characterized the recruitment of handpickers for the preceding score of years had at long last come to an end.

Dickman: This is my own question: In terms of the overall social good, have there been advantages from the use of the mechanized tomato harvester?

Roth: In my opinion there have been tremendous social benefits derived from the mechanization of the canning tomato harvest. Number one, as the acreage has increased, the number of domestic workers that on the average are participating on the harvest is far greater than it was before. In 1974, at the peak of the canning tomato harvest here in California, the employment development department estimated a work force of approximately twenty-six thousand workers engaged in this activity. This compares with approximately five thousand domestic workers in 1956 at the peak of the bracero program. Of course, part of this increase was due to almost a doubling of the tomato acreage.

The working conditions entailed in the harvest are much better. They are better to the extent that women, and youth, and girls gladly and profitably participate in this important harvest. In

Roth: addition to that, along with mechanization usually comes an increase in the wages that coincide with the increased skills that are involved in the activity.

Dickman: Thank you very much.

ROBERT M. UNDERHILL AND JOSEPHINE OPALKA

Dickman: Mr. Underhill, would you identify yourself, please?

Underhill: I am Robert M. Underhill, vice-president of the University of California, emeritus, and secretary and treasurer of the Regents, emeritus. I served the University consecutively for forty-five years up to the time of the conclusion of my services in the summer of 1963. I had a few months of service in 1915, right after graduation from the College of Commerce.*

I was a member of the University of California Patent Board from its inception, and during the last seven years, up to the summer of 1963, I was chairman of the Patent Board. In my assignment as treasurer of the University, I had charge of the management of all the investments of the University: all assets that were not used actually in the campus or field operations, such as the buildings, the lands, Davis, Berkeley, and so on. Therefore, the patent administration, being an asset just like a security, fell under the purview of the treasurer. For that matter, while a member of the Patent Board I was also in effect an executive officer of the Patent Board even before I became chairman. Negotiation of patents during my incumbency as treasurer and chairman of the Patent Board, and even before I was chairman of the Patent Board, fell in my department. It is for this reason that I took charge of, to some extent, the attempt to get the patents and license the patents on the matters we are now to discuss.

From 1964 to 1967, I was called back to duty for one-fifth time, particularly in connection with government contracts, but not in connection with any of the matters we will be talking about now.

Dickman: Miss Opalka, will you identify yourself, please?

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* Succeeded in 1943 by the School of Business Administration

Opalka: I"m Josephine Opalka and I'm patent administrator.

Inventors of the Tomato Harvester

Underhill: In the early part of 1960, attention was brought to the University--to the Regents--through a letter, I believe, probably from Dean [Daniel G.] Aldrich, [Jr.,]* that the Department of Agricultural Engineering at Davis, through a man named Coby Lorenzen, and a fellow named I. J. [Istvan Janos] Szluka had developed a mechanical tomato harvester.

Opalka: He has since simplified it to Sluka.

Underhill: I think there was some other man later on in the picture, whose name I don't recall.

Opalka: Hill.

Underhill: I don't find him in the file.

Opalka: The only two University inventors on the tomato harvester are Lorenzen and Sluka.

Underhill: Right. But who was this other fellow?

Opalka: The third fellow came into the picture after we licensed the invention to Blackwelder. Frederick Hill is an engineer on Blackwelder's staff and by making the improvements to the original harvester, he became a co-inventor. Eventually, even the original patent application on this harvester included his name because the patent office directed the filing of divisional applications. That is, the original application was divided into these separate cases. At that time the inventorship was changed to include Hill.

The Blackwelder Licensing Agreement

Underhill: As I stated, information came about this invention of a mechanical harvester and on March 8, 1960, as secretary and treasurer of the

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* Dean of the Universitywide Division of Agricultural Sciences, 1958-1963.

Underhill: Board of Regents, I went to the finance committee and reported this development and asked that the license be given to the Blackwelder Manufacturing Company of Rio Vista.

Actually, efforts were made to interest some other organizations at the same time. I didn't know Blackwelder, but I presume that Blackwelder was well known to the engineering department at Davis. He probably was in there and around and he was also making some other equipment that had come out of Davis. Something to do with beans--bean cleaner, wasn't it?

Opalka: I think he was well known for having developed the sugar beet harvester.

Underhill: I tried to interest a food machinery company--not knowing anything of Blackwelder. This was a great big outfit: they had a big sales force, and so on. But they'd have no part of it. I tried to interest International Harvester and they didn't seem interested at all and I think there were some others--Magnuson, I believe.

Well anyway, they showed no interest in this matter whatso ever. But Blackwelder was acquainted, I'm quite sure, with the people in the engineering department at Davis and the matter was referred to me and I made three visits to Rio Vista--one time with Mark Owens, Jr., who was a member of the Patent Board and acted as our counsel as well. I think, he is now chairman of the Patent Board. I went there and we talked to the Blackwelder crowd, and they wanted the license and were willing to go ahead.

There were some very difficult problems. In the first place, they had to expand their operations, which required some financing, and I understand they had to get some more bank loans to undertake the costly development because the machinery is intricate and expensive. The Regents went along with this arrangement and the first matter was to negotiate a license for a period of six years at 5 percent royalty, including a minimum production of two harvesters a year. The first two were produced for Davis itself, at the University's cost, so the University could work with it and make more changes, and for a tomato grower named . . .

Dickman: Les Heringer.

Underhill: All right.

I don't know where he was located, but he was going to pay for it, or half of it, and he was going to work it out on

Underhill: his farm. So two were produced immediately and Blackwelder continued production, so in 1962 they produced . . .

Dickman: Twenty-five, I think.

Underhill: I've got it here...tried to clip this, this morning. They had produced enough to pay $16,000 in royalties by that time.

The earlier machines did not work out well, and they all had to go back to Blackwelder for repair or remodeling and redoing. Therefore, the Patent Board and I recommended (I was also acting as the administrator of the University's investments) that the Regents suspend the requirement of the minimum royalty until they could get this thing going, and Blackwelder did put in something like $14,000 or $15,000, I think, of their own money to cure the bugs in the machines that had gone out early. Then the matter got going again--here--twenty-five units were produced by 1962 and $18,000 of royalties were paid.

Dickman: What letter are you reading from?

Underhill: I'm reading from a letter of October 12, 1962, from Blackwelder Manufacturing Company, E. F. Blackwelder, President, to the Regents--to my attention as treasurer of the University. At this point 5 percent royalty was paid.

Now these machines in the early days started at $15,000 apiece, and I think they went up to about $25,000. Since that time, I think, they have become much more sophisticated, and probably much more expensive. I did report to the finance committee of the Board of Regents on October 19, 1962, that the company had spent $40,000 on the recalled machines and the remodeling of the machines. This is set forth in the minutes of the Regents.

The "UC-Blackwelder" Trademark

The company then requested the University to allow its use of the label or trademark "UC-Blackwelder" on the machines. This brought quite a bit of discussion in the research committee of the Board of Regents and in the finance committee because there was a question whether putting "UC" on the machines and approving this would involve the University in some problems with Blackwelder. There is a law which, except for the grandfather clause, prohibits use of the name "University of California" or "UC" as a trademark or in advertising. But there are

Underhill: places around town which use "UC" commercially because they had it as a grandfather right.

Here the question comes up whether Blackwelder was going to be allowed to do this or not. Blackwelder wanted to use the term and it seemed, certainly to me, that we were losing a good bit if we didn't take some credit for these good deeds and good acts, and so on. And the Regents finally agreed that he might stamp "UC" on the machinery. The matter has gone on in that respect.

Dickman: Has the University of California made any other similar arrangements with a commercial enterprise to put "UC" alongside of the name of the company?

Opalka: Yes. As a matter of fact the University has an established policy permitting use of the term "UC" in certain circumstances. We have a prosthetic device that was developed at Irvine called the UCI-Knee. It's an implant.

The education code of the state prohibits the use of the University's name in advertising except by special permission of the Regents. The Regents have delegated that authority to the president and the president in turn has delegated it to the chancellors.

Dickman: I see.

Opalka: So it is permissible.

Dickman: Is that the one exception that you know of?

Opalka: Yes. However, I know that the general counsel is on the alert for any misuse of the University of California's name in advertising, and he writes letters to those people who are not complying with the law.

The Problem of Exclusive Licensing

Underhill: I have a recollection, although I don't recall the details, that the University was criticized for the exclusive licensing, and I believe it was the Blackwelder case. But the Blackwelder outfit was the only one that was willing to take this matter on, as I told you, and some protests went to the governor and the governor referred it back to the University.

Underhill: Our position was clear. We had made an exclusive license which we had a perfect right to do. A holder of a patent can do what he wants with it. We had licensed the harvester to Blackwelder, and Blackwelder had carried on vigorously and in good faith and made harvesters available to the growers. We clearly said that we had the right to do this and for those who had the opportunity before and then wanted to get into the act--it was just a little bit late!

Opalka: I'd like to confirm what Mr. Underhill said about complaints being received in the University over its granting exclusive licenses. This happens frequently. When an invention is first made, it's very hard to license it. Sometimes you can't even give the invention away, because it's in the very formative stages and it takes quite a bit of time and money to develop that invention for the market.

Statistics show that the cost of making an invention up to the prototype stage, that is, from its conception up to the prototype, is only about 5 or 10 percent of the ultimate cost of placing that invention on the market. So we look to private industry, you see, to actually develop inventions for the market. Patents that come out of the University are called "bare bones patents," because that's all they are! And industry has to put up the capital and apply its expertise to place the invention on the market. It takes thousands and thousands of dollars, and in the case of new drugs it takes millions!

No company is going to make an investment of private capital unless it has some assurance that it can recover its costs, and the way to handle this is to give the company an exlusive license for a limited period of time, at least. So we have the "Johnny-come-latelies" to contend with--the companies that passed up the original opportunity to license. When the licensed company gets the product on the market and the sales potential and the economics become more evident, the competition wants to get on the bandwagon, and that's where the criticism of the University comes in. But it's usually quite unfounded.

Dickman: If there are a number of companies who are asking simultaneously for the license protection, how do you determine which one is given the exclusive?

Opalka: That very seldom happens because we really have to go out beating in the bushes for licensees. Prospective licensees do not line up on the street, waiting (laughter). It is very seldom that we have that choice. Some Regents have suggested, as have some critics of the University, that we put these inventions out to bid, as it were (laughter). As I said before,

Opalka: sometimes you can't give the inventions away, let alone get anybody to bid on them! So we very seldom have that problem of too many offers, but it does occur from time to time. When that happens, we look to the company that is most capable of doing the job and that makes the best offer. Some companies assert they can do a good job, but after checking their capital we find they just haven't got what it takes to develop the invention for the market.

My actual knowledge of the details of a lot of these things is rather fuzzy and I really don't care to comment on the prosecution because it's ongoing--patent applications continue to be filed. We do hold between twenty-six and twenty-eight patents as of today on the harvester and there are more coming. So the invention is very much alive, I'm happy to say.

Underhill: One of the big companies that I mentioned as having had a chance at this harvester in the early days would have taken it on, but it wanted to suspend all royalties for two years and would not be willing to assign the improvements and betterments which are quite important in some inventions, and so on, although assignment of improvements is no longer insisted on.

In the absence of these two requirements, a company could stall development of an invention for two years or more, and we've had that experience. Thus two years of your patent time is beginning to go--two of your seventeen are passing by--and this must be taken into consideration in the choice of a licensee. The question is, will the company promptly undertake development or is it just going to try to use University technology to find some other way of making something like it for themselves and not assign their improvements and betterments? This is something that is important in deciding who is licensed. It seemed to us that Blackwelder was acting in good faith and it's now certainly evident from the record that he did!

Dickman: Just for the record: as you know, Mr. Blackwelder was awarded an LL.D. by the University of California at Davis. I wondered if you office was asked for its recommendation on that?

Underhill: No, I didn't know that, and I'm delighted to hear that! Every opportunity I had to meet with Blackwelder was a pleasant occasion. He became a very nice acquaintance, and I'm delighted to hear that he received the honor. Now they're kind of rare. They don't give them anymore.

Dickman: That's right.

The Harvester: A Success

Underhill: I'd like to have Miss Opalka tell you something about what this harvester did in the saving of the tomato crop although I presume you have gotten that at Davis, anyway.

Dickman: I'd like to have it from you.

Opalka: With regard to the importance of the tomato harvester to California industry, Dean [Roy] Bainer* could probably speak to this in more detail than I can. Blackwelder had nineteen or twenty machines in the field when the farm labor disappeared. We feel that the tomato harvester literally saved the tomato industry in the state. I was told that some of our tomato growers were actually shopping around for land in Mexico.

Dickman: Several canners had already moved to Mexico.

Opalka: Yes, the threat was there.

One reason for the tomato harvester's success is that Blackwelder didn't just sit back and rest on his laurels after he got the first machine in the field. He continually improved and refurbished the old machines so that the growers have had the best quality and the best performing machines. I would attribute the success of the harvester to Blackwelder's diligence in keeping up with technology and automating things that could be automated. Even things like providing shade for the people who ride the machine have been a help--they've helped the worker.

Underhill: Continual improvements have been made and I have gone to the minutes of the finance committee of the Regents and looked into the matter and I find that (pause) well, as I stated before, there were twenty-five built by 1962. I didn't continue in the activity beyond '63 and very little in '63. The patent applications were going on and the attorney in this case was [A. Donham] Owen. He died a little while ago and the work is being carried on by Robert Wickersham, who is a member of the Owen firm. I think the matter is still pending and I don't think I can give you very much more. It may well be that someone else could go through this file.

I see that sales, for instance, in 1969 were $287,000, producing royalties of approximately $15,000. Miss Opalka has informed me that up to the middle of '74, $764,363 were received in royalties on the harvester.

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* Dean of Engineering, University of California, Davis, 1962-1969.

Inventiveness at Davis

Dickman: Anything else you care to add?

Opalka: Let me tell you this: I don't know if you want to record this but it concerns a sampling invention that was made at Davis.

Dickman: Are you referring to Professor Mike O'Brien?

Opalka: Yes. He's a very--what shall I say?--a great inventor. He's got, I guess, more inventions at Davis than any of the other men there. He invented a tomato sampler a few years ago, to sample and grade tomatoes.

Dickman: Yes.

Opalka: We had that licensed to a very good company in Yuba City--Steel Products, Inc.

Recently Clint West, who is the son of the founder of the company, I believe, and also a very good engineer, decided to adapt the tomato sampler for sampling onions. It was interesting to learn from the initial grading and sampling of onions with that sampler, that up until this time the buyers of those onions were purchasing 17 percent dirt (laughter) along with their onions! In other words, one out of every six onions was dirt (laughter)! This machine has been used only a very short time now for onion sampling, and the people are just delighted with it because they have already realized its value. They are not paying for dirt any more (laughter).

Underhill: One of the first inventions at Davis that I ever came in contact with was that walnut cracker!

Dickman: Oh, yes indeed (laughter)!

Underhill: I went to Davis and we took a look at this thing, as to what could be done with it and so on, and the nutcracker never succeeded because it broke the membrane on the nut--that little brown skin! In the shelling of the nuts they like to have the whole half or the whole nut, and if you are going to put it on a piece of candy or in a cake you like that little golden brown top on it. So we never could get anywhere with it in those days.

I remember I thought we ought to be able to license those things for the Fourth of July (laughter)! When I was a kid in San Francisco we were always allowed to shoot off firecrackers, and only on the Fourth of July. The Chinese had them on New Year's and so on, and when they put the gas into that gadget and took the nut over the flame--you had a better Fourth of July than I ever had as a kid! We were never able to sell it for that purpose (laughter)!

GEORGE A. JOHANNESSEN

Dickman: Would you give your name and identify yourself and then something about your own background.

Johannessen: My name is George A. Johannessen. I am a horticulturist and tomato and pineapple breeder, and am currently manager of the Processing Tomato Advisory Board. I received my B.S. from Rutgers, M.S. from Purdue, and Ph.D. from Cornell. I was an associate professor of vegetable crops and pomology at Cornell University, western area agronomist for American Can Company for seven years (with headquarters in San Francisco) covering fruit and vegetable crop production in western United States, western Canada, and Hawaii. My work included the solving of production problems and also forecasting production of all processing crops for tinplate purchases and manufacturing schedules for American Can Company.

I left American Can Company to become head of the plant breeding department for the Pineapple Research Institute of Hawaii and an affiliate member of the graduate faculty at the University of Hawaii. I returned to California in 1964 as director of raw product research for California Canners and Growers. In 1968, I became the first director of the California Tomato Research Institute which was initiated by the California Tomato Growers Association. Some others who became members and supported the California Tomato Research Institute were California Canners and Growers, Tri-Valley Growers, Coastal Valley Canning Company, Escalon Packers, Bank of America, Continental Can Company, Wells Fargo Bank, Fleetwood Industries, Chevron Chemical Company-Ortho Division, Rheem Manufacturing Company, Amax Chemical Corporation, and West Hills Seed Company.

In an effort to widen grower support for tomato research, and to provide funds for broomrape eradication, the Tomato Growers Association initiated an effort to establish a marketing order for processing tomatoes in California. This was successful and beginning in 1972, 100 percent of the processing tomato growers began contributing to the support of these activities.

A major goal, like that of the California Tomato Research

Johannessen: Institute, is to help the industry solve its problems and improve varieties and practices that will provide a better product for processors and consumers. The other goal is the eradication of broomrape, a parasitic plant which attacks the roots of tomatoes and feeds at the expense of the tomato plant with a resulting loss of production.

I was appointed manager of the newly formed Processing Tomato Advisory Board in 1972 with headquarters in Livermore. Now in its fourth year of funding tomato research, primarily at the University of California, we have supplied close to $430,000 and this year, 1976, will provide another $200,000 for research. Through 1975 the board allocated $405,000 for our broomrape eradication program and budgeted an additional $275,000 for 1976.

Our research programs include variety development for improved yield and quality in mechanical harvesting varieties, control of diseases such as fusarium wilt, verticillium wilt, phytophthora root rot, bacterial speck and canker. We are funding research on the control of dodder, nutgrass, and nightshade--weeds resistant to the herbicides now in use. This resistance to our herbicides has contributed to the very rapid increase of these weeds in California tomato fields.

We are funding research in Extension through farm advisors designed to provide more uniform and more reliable evaluation of tomato varieties in California. All varieties are now tested and scored in the same manner, and we can put more faith in the reports on variety evaluations throughout the state.

We have research under way on varieties that will set and develop fruit under high temperature conditions.

Dickman: What amount of money would you estimate, approximately, your organization makes available for research each year?

Johannessen: In 1975, and again in 1976, we've made available close to $200,000 to the University of California for tomato research.

Dickman: And, how is the money raised?

Johannessen: The money is raised by an assessment on each tomato grower. The advisory board recommends the assessment rate each year. The director of food and agriculture approves it. Our board consists of eleven members and eleven alternate members--one of each from each of the eleven districts. In addition, we have a member-at-large and an alternate member-at-large, plus a public member and alternate public member who represent consumers.

The maximum assessment rate is ten cents per ton. In 1975, the assessment rate was seven cents a ton. In 1976, it is the

Johannessen: same. Our 1975 budget was close to $490,000. In 1976, it is $566,000.

Dickman: How many commodities operate under marketing orders?

Johannessen: There are in excess of thirty marketing orders in operation in California at this time--most of them have provisions for research funding.

Dickman: And they can be voted out of existence by the members?

Johannessen: Yes. Some orders are setup for a specified period of time--either one year, three years, five years, or indefinitely, but with provisions for terminating the order by a vote of those participating.

Dickman: How are you tied in with the State of California?

Johannessen: We're tied in with the state because of their power to tax under the Marketing Act of 1937. The state is authorized to tax every grower of the commodity for which a marketing order has been approved. Because of this, we fall under some of the limitations or guidelines of the state. However, every penny collected for this program is processing tomato growers' money--money earned by tomato growers. However, the state attorney general ruled recently that because of the taxing power of the state to collect these monies they have been classified "public monies."

Dickman: The processing tomato industry in California is probably the largest food crop?

Johannessen: The processing tomato crop is the largest food crop produced in California.

Dickman: I understand that last year, if you were to consider all of the revenue producing activities associated with this industry, that it brought into the State of California nearly a billion and a half dollars.

Johannessen: The value of the raw product alone in 1974 was about $340 million. The value of the finished pack exceeded a billion and a half dollars. In 1975 the raw product value was over $400 million with a finished value of some $2 billion.

Dickman: And, yet the state nearly lost this industry back in the early sixties.

Johannessen: Yes, it was very much in doubt at the start of 1965, the year braceros were eliminated from the picture. Several canners, including Tri-Valley, and me for Cal Can, and other companies, made surveys of Mexico thinking they might have to move to Mexico

Johannessen: in order to stay in the processing tomato business. But, mechanical harvesting here in California in 1965 proved so successful that it laid to rest that fear. Since then, we have continued our steady growth in volume, quality, and markets. By 1968 our harvest was completely mechanized, in 1954 we produced 1.3 million tons; in 1964, 3 million tons; and in 1974, 6 million tons of processing tomatoes. Production of processing tomatoes has been doubling in California every ten years. In 1975 California produced and delivered to processors 7.5 million tons--all mechanically harvested. The trend is clear. California doubles its production of processing tomatoes every ten years.

Dickman: What are the factors, in your opinion, that contributed to that steady growth?

Johannessen: A combination of at least three elements have been mainly responsible. These are: 1) the development of varieties suitable for mechanical harvesting--high-yielding varieties of high quality; 2) the development of economical and efficient high-volume harvesting machines that do a good job, and 3) the management ability of the California tomato grower. Our producers have mastered the art and science of producing the new mechanical harvesting varieties and of efficiently operating the machines that have been developed through research. Our continued growth is due in large part also to the wide consumer acceptance of California processed tomatoes and tomato products. For many years, up through the fifties and the early sixties, California produced about 60 percent of the total United State's tomatoes for processing. With the advent of mechanical harvesting, and grower know-how here in California, this has steadily increased until now California enjoys close to 85 percent of the total U.S. production of processing tomatoes. This is good evidence of consumer acceptance and the market demand for our products.

It is well known in the processing industry that processors will locate and process tomatoes where they can do it the cheapest. Evidently, California fills the bill. We have a dependability of supply of high-quality tomatoes and tomato products and the most efficient tomato production in the world. We are also the only place in the world where 100 percent of the harvest is mechanized.

Dickman: Why do newspaper reporters talk about the bad taste of tomatoes and square tomatoes--what are they referring to?

Johannessen: There was an article by Ellen Goodman in the San Francisco Chronicle [June 1, 1975] which was filled with erroneous statements, and it is very evident that newspapers, such as the Chronicle, are not very discriminating in the type of information they make available to the consuming public. The statement was made that Dr. [Jack] Hanna's VF 145 varieties were picked green for the fresh market and were tasteless. To my knowledge, Dr. Hanna's

Johannessen: VF 145 mechanical harvesting tomato has never been marketed as a fresh market tomato. It is always harvested at maturity for use in processing. It is served to the public in the processed form--either as whole tomatoes in a can, or as stewed tomatoes, juice, soup, puree, or ketchup. These types of articles do a lot of harm, primarily because of the falsehoods which are spread to the public. I think there is a responsibility on the part of the newspapers, as well as the authors, to be honest in their critical comments. Besides all that, a vine-ripened VF 145 tomato is a delightful fruit eaten fresh.

Dickman: And, the Chronicle does this, whereas if they were to ask one of their own columnists, Henry Schacht, he could certainly have set them straight.

Johannessen: That is correct. Henry may have something to say about this one.

Dickman: You were talking about, in effect, the cultural revolution and that the growers must be able to take the information they receive from the University, from the farm advisors, and then put it to practical use. With harvesters costing $65,000 each, quite obviously there is a great deal of money invested and it must be used properly. Can you describe some of the specific things that you had in mind when you were talking about the necessity of the grower putting into effect the things that he gets from research?

Johannessen: Well, now in 1976 with electronic sorting being installed on perhaps as many as three hundred to four hundred harvesters, the cost of a 1976 harvester is running more like $110,000.

Growers watch closely results of variety trials and adopt those varieties that have proven to perform well in their particular area of production. Over the years we have gone from three to six thousand to thirty to fifty thousand plants per acre increasing steadily the yield per acre. Over the past twenty years acre yields have increased by eight tons, five of these in the last ten years.

We have seen growers adopt herbicides for weed control which has greatly reduced costs of production and harvesting, and improved yields. Growers have learned to shape and provide smooth, level, clod-free beds for efficient machine harvesting with minimum pickup of dirt in their deliveries.

We have spent much time on the management of irrigation, one of the most important factors in the production of tomatoes. We have learned how to irrigate our seedlings up and produce tonnage, quality, and the concentration of maturity necessary for an efficient and profitable once-over harvesting operation.

When we first got our machines in the mid sixties, we figured

Johannessen: We pack a minimum of 50 million cases of canned corn, and 40 million cases of beans and peas a year. Yet there is no place on the family dinner plate for processed tomatoes served as a vegetable. I say we get on that dinner plate with a tomato product with the same level of demand and uses as canned corn, peas, and beans. Using tomato paste as a base, we should make a good tasting, nutritious, attractive product, and encapsulate it so it can be heated on the stove and served on the dinner plate in the same manner as canned peas and corn. The side dish, which used to hold whole canned tomatoes, is gone from the dinner table. It's not coming back.

I am surprised at how slowly the industry has taken up the concept of the bulk storage of tomato paste or concentrate which two of the major national processors have known about and practiced for at least ten or fifteen years. Now with the development of the Purdue research on bulk storage in large steel tanks being offered to all processors in the world, I believe we will now see a lot of tomato pulp storage tanks--fifty thousand, one hundred thousand, or one hundred twenty-five thousand-gallon tanks--spring up here and across the country. Many will be located in the East and Midwest, but those eastern and midwestern tanks will be filled mostly with tomatoes grown in California, then partially processed here into 15, 20 or 30 percent paste. The product will then be shipped in sterile rail tank cars to the East and Midwest, or to the Far East or Europe in containerized ships for remanufacture. This will be a real shot in the arm for the processing industry of these areas. But, importantly, it will be mainly California grown tomatoes that will fill these tanks. Tomato products will be remanufactured from this product five days a week into whatever container size or tomato product is most profitable at the time, with indicated adjustments to the market demand being made with a minimum of time, effort, and money.

ALBERT MARTIN "FUM" JONGENEEL

Dickman: When did you start planting tomatoes?

Jongeneel: Oh, we've been into the tomato business, I suppose, for ten years. But we don't actually raise the tomatoes ourselves. We sublet tomatoes. And we have a couple of men that specialize in tomatoes and move them around on our ranch to get the rotation necessary to keep the diseases down. So we don't actually farm the tomatoes ourselves.

Meeting Jack Hanna

Dickman: When did you first meet Jack [Gordie C.] Hanna?

Jongeneel: Must have been in the twenties on Ryer Island. He lived on Ryer Island on the property we are now farming. He and his family lived there for several years. I can't recall how many.

He was then specializing in the asparagus centipede. At that time, the asparagus industry around here was mainly white asparagus, and the centipede made the white asparagus unusable because of the punctures. Jack was the one who started trying to find a cure for it. We used Chloropicrin and all these other sort of poisons, I guess you'd call them. Then he went from that to looking for a variety that was resistant. I don't know if that was very successful because the centipede seems to like any asparagus. He spent days and days on his hands and knees out in the dust looking for centipedes and centipede eggs, and when he found a pink egg you'd think he'd found a garnet. I don't know what he did with it, but that was one of the big things.

That's really the time that I worked with Jack on asparagus because at that time I was in charge of the Del Monte asparagus fields. We used to have to get the asparagus to the cannery in a matter of hours. Now it's just a matter of days when they get around to canning the darn stuff, so it's altogether different.

Dickman: Was Jack working on tomatoes at all?

Jongeneel: Not at that time. Tomatoes weren't very much of a crop then in the Delta, because we were always too late, and the canners weren't interested in Delta tomatoes. So I don't exactly remember the time that Jack switched from his asparagus to tomatoes, or the yellow watermelon, or all the rest of these things--now he's also breeding sweet potatoes. (I didn't think they were so good.)

So, when Jack actually got into tomatoes I don't know, but in the bull sessions that we used to have, to throw around our ideas, there was one where we were talking about this mechanization. I told Jack (the only thing I do remember), "You get the tomato, and I'll build you a machine if nobody else will." It was an idle threat, but it was enough to get him started.

The Impetus for Invention

It was impossible, at that time, to see how you would continue to get the labor to pick the big, sloppy tomato. That's how it came about.

Dickman: When was that, by the way? About the early 1940s?

Jongeneel: It must have been during the war, when you couldn't get any help. And the help got harder to get along with. And I guess I was a little hard to get along with, too. Mechanical harvest is just a matter of necessity, I thought, to look forward to if you want tomatoes.

No different than today. The asparagus industry is leaving because we haven't been forward looking enough to make the asparagus mechanically harvested at a price that anybody can afford to buy it. The tomatoes were going out of sight, at that time.

And of course the canner has to change. If it doesn't become an industry, then one grower can't do it alone without having an outlet. So it takes somebody like you at the University to coordinate the industry viewpoint. And I think that's where Jack came in. And, that's where Roy [Roy Bainer, dean emeritus, College of Engineering, UC Davis] came in. He kept the industry--all phases of the industry--interested.

Specifications--as I remember, you'd have to drop this thing three feet and still have it usable. Jack took it seriously and went after it. So this developed because of necessity. The first few tomatoes that came out, you could drop all right, but they weren't edible: they were all core. So that didn't do us

Jongeneel: any good. And then I didn't have to make good on my threat because the University produced a harvester. So, I guess that's about where it started.

Dickman: What kind of labor were you using at that time?

Jongeneel: I suppose at that time it must have been Filipinos, because we've gone through Filipinos, Turks and Hindus, Japanese. We started out with, of course, the Chinese. Now all the Filipinos are bellhops in the hotels and they don't want to work on the ranch. Since they have gotten their independence, we don't have the importing any more of the Filipino labor.

We have asparagus cutters on the ranch right now that were cutting asparagus in 1918 for us. And you know how their backs feel. They're dying off, practically. It's just impossible to get young people to do it. I think that's the same way with the tomatoes. And now they may be pricing the tomatoes a little bit out of market when it comes to the cost of machinery. One hundred and ten thousand dollars for one machine!

Dickman: With electric sorting.

Jongeneel: Oh, yes. It's unbelievable.

The Perils of Innovation

Dickman: After Jack started working on the compatible tomato, he says that everybody in the industry laughed at him. He wouldn't even tell anybody what he was doing because they ridiculed him. You had faith in it, however?

Jongeneel: Well, I think that's part of innovation--being ridiculed--that's the fun of it. I've been through that mill many times (laughter), as Roy Bainer knows. The minute you get something that's unorthodox, you really get shot down. That's like Jack getting shot down with the square tomato. He just used the wrong language, but they sure picked him up on it.

We were actually picketed when we built the first beet harvester, because we were putting people out of work. When they came down, they threatened us with this, threatened us with that. But that's just part of living, I guess.

Dickman: Did you talk much to Jack over the ten, fifteen years that he was breeding the VF 145?

Jongeneel: I would have no idea how many times we talked about it. Oh, it depended, most likely, on where we happened to meet and whether

Jongeneel: we'd had a martini or whether we hadn't. It takes a lot of conversation and encouragement sometimes to keep going in the face of criticisms that you get. I guess if you weren't a little bit stubborn you wouldn't stick with it. And Jack has the knowledge and he has the patience and he luckily has the stubborness to go with it. It's been my good fortune to be with Jack over the years. Lately, of course, I haven't seen him. He's traveling the world, chasing around for tomatoes and for Peto Seed Company. I couldn't say how many conversations we had at all.

Dickman: Is there anything else about that particular event that occurs to you?

Jongeneel: No, except I was glad that the University built the machine and I didn't have to build the machine, because the cost of building machinery these days is really getting difficult to do on an experimental basis. I don't think we could build machines like we used to, becuase we used to get men who could braze, who could weld, who could cut, who could "imagineer" things. Now the new breed of mechanics that we have are very difficult to deal with if you don't have a blueprint. And if you have a blueprint then you have the machine already made.

Dickman: Thank you very much.

CHARLES M. RICK, JR.

A Cytogeneticist Looks at Tomatoes

Dickman: Dr. Rick, when did you first come to Davis, and what were your duties?

Rick: I came here in 1940 as an instructor with teaching and research responsibilities. They outlined to me my research responsibilities as cytogenetic problems in vegetable crops and in those first years I pursued a number of problems in asparagus sex determination, and so on. Then in 1943 I developed my first interest in tomatoes. I gradually shifted over to that crop, working on basic cytogenetic problems ever since.

One of the lines of research that I have been interested in and which has been followed by the canning tomato breeders is the use of the so-called jointless type of tomatoes. The jointless gene, which is most popular at the present time, is one that I picked up in a wild tomato from the Galapagos Islands. That tomato has a fruit about the size of a small pea and has an orange color when it ripens. But by making the appropriate hybridization and following through with a series of backcrosses, we incorporated this jointless character in large red-fruited tomatoes.

The jointless type prevents the fruit from separating readily from the vine. In many varieties the machine will cut off the plant and lift the plant onto the machine, and in the process of doing this, many fruits are lost by shattering. Now we know that the so-called j-2 gene will greatly reduce the amount of loss from this source.

Other work that I've been engaged in has been related to the increase of soluble solids in the tomato. Here I took as my source the small green-fruited wild tomato from the interior valleys of the Andes in southern Peru. This species has an extremely high soluble solids content. And, again by a series of backcrosses, we were successful in transferring an appreciable amount of this high soluble character from the wild tomato to a large red-fruited type. This material has also been released to breeders so that it is available for whatever use they can make of it in their breeding

Rick: program.

Dickman: What was your connection with the development of the VF 145?

Rick: Well, my connection, I suppose you'd say, was rather remote. I was always an interested witness, and if there were any materials that might be useful for that program in my material I always brought them to the attention of Jack [Gordie C.] Hanna. Materials of that type had the so-called jointless character and a number of other traits that were developed from wild tomato species.

Dickman: Can you recall the atmosphere back in the forties when Jack Hanna was working on the problem, before the compatible tomato was developed?

Rick: Yes. I was tremendously interested in the work and followed the progress of it every season. There certainly was a great deal of skepticism in those early days. There were many people in the industry who felt that this was a completely unnecessary development, but Jack Hanna was a real go-getter. He wasn't to be deterred by such attitudes. He went right ahead with his objectives and, of course, finally won out. One of Jack's attitudes--how shall I say it?--he had a very strong feeling (and I'm sure he still maintains it) that one does not wait for the industry to tell the investigator what to do, but that the investigator should go to the industry and tell them what should be done. He was a firm believer in that attitude. I think in this case it certainly paid off.

Dickman: Can you recall your own feelings in the matter as this work developed over the years?

Rick: Well, I'm not sure I can recall how I felt. At the start it didn't take me very long to become convinced that it was the right way to proceed. As I said before, I was out there working on my own projects but never lost an opportunity to see what was happening in their program. Of course I could never forget the first designs of the machine that was developed by Coby Lorenzen. Some of the contraptions that were first tried out were, to say the least, highly amusing.

But that, again, was nothing to dismay those people. They went right back to the shop and came out with gradually improved designs.

Dickman: Was there anything in their project that was a help to you in your project?

Rick: Oh, absolutely. I suppose there was more in terms of benefit that flowed in that direction than from me to them. Jack was conducting his breeding program on a very large scale. And whenever he found interesting off-types in his lines, he always called them to my attention. And quite often we did pick them up and make studies

Rick: upon them.

Many of the useful genes that serve as markers for the tomato chromosomes came from that source.

Dickman: The tomato has gotten a bad press lately regarding its taste, its vitamin content, etc. What are your thoughts?

Rick: Well, I think the press is a pretty poor source of information (laughter) for that sort of thing. I think the truth of the matter is that the type of tomato developed for the canning industry is not a very good one for fresh market. And people are apt to confuse these two standards. The whole situation is rather complex. It's not easy to summarize the situation in regard to quality. There are so many factors that are involved.

The breeders might, for example, put out varieties that are of very high quality. Yet, if they're not handled properly by the shippers and the middlemen, the consumer still will not get a good product. I know there was a recent test conducted in Michigan in which they planted a group of the old-time varieties that people remember with such great affection, as well as a sample of some of the very recent varieties, and submitted the ripe fruit which was harvested from these different lines to a taste panel. The average evaluation by the panel was about the same--that there seemed to be no general trend toward decreased flavor or other faulty characteristics.

Part of the difficulty, of course, is that people expect to have top quality tomatoes on the market throughout the entire year. In the off-season, they have to be shipped great distances and this means picking them in the green or pink stage, often ripening them artificially. So it's really quite difficult to put a high quality tomato on the market under those conditions.

Now, if you go back to the so-called "good old days," you find that there were very, very few tomatoes on the market in the off-season. And if they were, they were greenhouse produced and extremely expensive. The tomatoes that people consumed in those days were mostly produced during the main growing season, and also produced locally.

Dickman: Thank you very much.

MELVIN P. ZOBEL

Origins

Dickman: Mr. Zobel, will you tell briefly something about your origins and where you were educated, and your interest in vegetable crops?

Zobel: I grew up on a vegetable farm in Watsonville [California], and tomatoes was one of the crops that my father grew. They were shiping tomatoes; he shipped them to the San Francisco market. Consequently I had a lot of background with tomatoes from when I was little on.

I went to Watsonville High School and after graduating I worked on the farm for several years and then decided to go on to college. Looking around I decided that I would like to go to Davis.

College Years

Zobel: My grades were such that I couldn't get into degree work, so I came up and enrolled in the nondegree program in the vegetable crops curriculum.

Dickman: What year was that?

Zobel: That was in 1938. I then transferred, after one year in nondegree, to a combination student. Then after one semester of combination status I qualified as a degree student. I finished the rest of my degree work here at Davis.

Dickman: When did you graduate?

Zobel: My university studies were interrupted by the war. I came back in 1946 and finally graduated in 1948. During the war they slipped

Zobel: in a couple of extra courses that were necessary, so it took me a little longer to finish up.

Dickman: How did the war affect you otherwise?

Zobel: I had an occupational deferment. Dessert Seed Company had to have a qualified person on their staff to qualify for contracts to grow lend-lease seed. I sat out the war in the Imperial Valley, working for them. Some people say I was lucky, but with frozen wages, and the Imperial Valley for three years, I don't know whether I was lucky or not. However, it was a good experience, even down there in the Imperial Valley. I was trial grounds manager, plant breeder, crew boss, Jack-of-all-trades (during the war you did everything), so I gained a lot of valuable experience.

Other Job Experiences

Dickman: What was your first job after you graduated from UC Davis?

Zobel: All the time that I was in school I worked for the veg crops department during free time and during the summertime. After getting my degree in February of '48, I was hired by the veg crops department as a specialist, to do test plot work in the Delta area. The purpose was to coordinate the veg crops department work with the Ag Extension people. I worked with and through the various farm advisors in the counties in the Delta. Most of the work was putting out fertilizer trials, variety trials, and other test plots of various kinds that veg crops department people wanted. Often the farm advisors wanted help with their test plots. I helped there, too. I worked in many fields with many crops and obtained quite a bit of experience during the five years with the department.

Dickman: When did you first meet Jack [Gordie C.] Hanna?

Zobel: I knew Hanna for a long time. When I was working in the veg crops department during free time and summertime, I worked part time for him. I also took classes in which Hanna was the instructor. One of the classes that was particularly outstanding was the vegetable variety class. The name of the course I don't recall anymore. It was always interesting to work and study under Hanna. He was thinking all the time and he was always pulling information out of you and making you stop and think what you were doing. It was an education just to be around him.

After working for the veg crops department for five years I

Zobel: shifted and went with a seed company located south of Sacramento--the Franklin area. I was there for two years. Then I spent another year as a fertilizer, insecticide, chemical salesman. This was a frustrating experience. From there I went into ag extension and I've been in extension for nineteen years.

Agricultural Extension Work: Tomatoes

Zobel: My experience with the processing tomato and machine harvesting goes back many years. All the time that I was working at veg crops, in conversations with Hanna, in picking the various experimental varieties (the vine type), the thinking--everything--was pointing in this mechanization direction, though we didn't really recognize or consciously knew what direction we were headed. It is a direction processing tomatoes were taking even if mechanization wouldn't have come. But the trend did make the transition to mechanization easier.

Instead of the large vine sizes, like the early Santa Clara canner, and some of the later ones that were also large vine size, the new varieties' vine size kept getting smaller and smaller because of worker preference. People liked to pick the smaller vine size. The fruit load was more concentrated; the hand harvest crews could pick more of the fruit at one time; fewer harvesters per field were needed. It's interesting that this was the same direction that we needed to go for mechanization. Actually, we were building in the mechanization direction whether we recognized it or not. The transition to mechanization was a big jump, but was not as big a jump as if we had to shift from the old original cannery tomatoes to the present cannery tomatoes.

Fortunately, some of the last developed hand-harvest varieties, such as the VF 36, VF 14, and Cal Pack 2, were small vines with concentrated fruit set. The cultural practices used for production of these varieties were the forerunners for production of machine harvest varieties. The production requirements were similar for both. Again, this transition was easier because the growers had already picked up some experience and could visualize the changes that were going to be required when they did get into machine harvest production.

I don't know just what year it was, but it must have been in the mid-fifties, Hanna came up with a prototype pear-shape variety which I would sure like to see now, because I think it would probably go. But at that time it was too far ahead, and the industry

Zobel: was not ready and the plant breeders themselves were not ready to accept this variety.

Dickman: The tomato had to be round?

Zobel: The tomato had to be round. The small-vined, concentrated, fruit-loaded plant--it was just hanging full of fruit--was too different. There was a lot of objection to it. They claimed the solids weren't there, and that it didn't have quality. It was just too different; too revolutionary. We were looking at tomatoes differently then than we do now. If the soluble solids weren't there, a variety was no good. Now we're highly interested in the insoluble solids as well as the soluble solids. Insolubles help make the tomato products thick, make thick paste with less boiling. I'm sure that these proto-type varieties probably would have fallen into the currently acceptable category. We don't have these varieties now, but it was good to look at them.

The test plot work showed that we were getting around sixty tons per acre. These yields were difficult for most people to comprehend but for research it showed what could be accomplished--a goal to shoot for.

After the initial varieties it was back to the drawing board. Jack Hanna started over with a new approach, with the rounds, and then kept working from there until we have our present varieties.

Dickman: Since so much of the development for the machine, as you have said, was done unconsciously, when did they consciously and deliberately start working with the tomato for the machine harvest?

Zobel: The exact date is difficult to pinpoint because I was not doing any of the plant breeding work. I was sitting in the background and watching what Hanna was doing, looking at the varieties that he was coming up with, discussing the situation with him. He was doing the mechanics of crossing and selection and direction. We were interested, but in the background: watching and wondering which direction we would wind up going, all the time thinking, "Well now, when these varieties do come, how are we going to handle them? What procedures are going to be necessary?" So we had quite a bit of time to think before the actual mechanization took place.

Dickman: Do you recall the time when Jack Hanna and Coby Lorenzen were working together?

Zobel: This was when Jack first came up with those pear-shaped crosses. They tried shaking. They tried undercutting. Before they ever put a machine together they hand shook and hand handled to get the

Zobel: feel of what kind of machine would be necessary. They tried to determine what procedures would be necessary, what ideas to eliminate, what new ideas that they would have to come up with. There was just an awful lot of thought and thinking that went into this thing before machines came along.

Dickman: Were you in on some of those discussions?

Zobel: Oh, sort of a shirt-tail member of the discussions, on the fringes. I put in two-bits worth here and an idea here and there--every little bit helps. Whether I did any good or not is debatable, but at least I like to think that I had some part in it.

I did watch the machines go from all sorts of different Rube Goldberg things into the one that they prototyped: the one that was used at [Les] Heringer's and on Dave Wilson's ranch. Prior to that, I watched Hanna and Lorenzen try the potato digger. The University had a potato digger so they thought they would try it.. The thing that is interesting now is to look at the current machines; they're not too far from a potato digger. Instead of cutting underground, they're cutting at ground level. Other than that it is very similar to a potato digger, so the potato digger was the most practical method of approach. Watching the tomato harvester develop was an interesting experience. I don't anticipate ever seeing anything similar to it again.

Dickman: Jack Hanna says that for a long time he was very reluctant to tell people in the industry what he was doing because they would laugh at him.

Zobel: This is true when he went to the industry, but with his fellow researchers he confided more; particularly to people that he had confidence in. I had known Jack for a long time, and we talked quite freely: the pros and the cons, would this work or wouldn't this work? There was a lot of discussion back and forth, and from this Jack would pick up perhaps an idea here and there, or a thought, and then proceed from there. (He did this with others too. I question whether I had much, if any, influence on his final decisions.)

But when he went to the industry, as you call it--no, he did not talk to them because they said it's impossible, not feasible, no way can you do it, and this type of thing. They defeated the whole procedure before they even looked at it.

Dickman: How about the growers? What was their opinion?

Zobel: Most growers were doubting Thomases, interested, but no way could

Zobel: they see how they could get it done. It boiled down to a "show me" procedure.

This was what we did during the early stages before we ever got into mechanization. It was a case of showing and telling, and retelling and retelling, repeating, and selling the growers, planting the idea, getting them thinking in terms of mechanization. I know that in our variety trials in the counties, when we first could get seed of some of these prototype machine harvest varieties, we would slip a couple of these in. Then when we held our field meetings for growers and for the industry we would point these out, show the concentration, show the type of fruit, how many were picked in one pick, and the feasibilities, the possibilities of mechanization. We had to continue to spread this information, so that when mechanization came it wasn't a completely strange idea. They had already been introduced to it. It wasn't a real hard-sell deal, but it was a case of, "All right, now we're faced with it, let's get with it, this is how you do it."

Dickman: Were there any growers who were particularly helpful or who were less skeptical than others?

Zobel: Yes, there were several key growers in this line. The Heringers were interested in it; they've always been interested in innovations and new procedures. They stuck their necks out a lot of times and it cost them some money doing it. But, agriculture has benefited from it in the long run. One other grower that I give a lot of credit to was George Iseri in Clarksburg--he's a small tomato grower who grows only tomatoes. He bought the idea early and got one of the original machines. Unfortunately, it was difficult for him to get away from his old habits, his implanted experiences of hand harvesting and growing for hand harvesting. . . .

Dickman: Like changing irrigation practices and that kind of thing?

Zobel: Yes. So he never became, I would say, a leader in the industry, but he was one of the first to buy the machine. I did a lot of test plot work with him; spacing, fertilizer, variety trials, and this type of work. He kept his machine running, but he always wanted to use handpick labor. It was difficult for him to make this transition from hand harvest to machine harvest.

Dickman: He represented in his thought a lot of the other growers, I would imagine. What was the main pressure, then, that influenced the growers to accept and use the machine?

Zobel: Well, actually the main pressure was the dwindling supply of labor and the excessive cost of this labor. We had the bracero program.

Zobel: It was a good program, but they kept throwing stumbling blocks in the way which made it more difficult to obtain labor and more expensive. Finally, they set a target date and said there will be no more imported labor available. This really triggered the thing.

The growers said, "Well, if we're going to grow tomatoes, going to have a tomato industry, this is what we're going to have to do." This is what put them into the machine age. If they wanted to grow tomatoes, they shifted and went to machine harvesting.

Dickman: Let's return to your own work. During these transition phases, what were you doing specifically?

The Transition Period

Zobel: Well, this transition period was an education process. I would like to think of it in terms of an outstanding bona fide ag extension effort--what extension should do in getting an industry to change procedures, to maintain the industry to keep it a live, viable industry. We started this well before machine harvesting became a fact, before there were any machines available; we talked machine harvesting at our training meetings, at our grower meetings, our production meetings. We put in machine harvest varieties in our variety trials; this was years before there were any plantings for machine harvesting.

Working With The Growers

Dickman: Was this in the early fifties, would you say?

Zobel: Mid-fifties, from '56 on. We were looking at plant spacings, clump plantings, twin rows versus single rows, working out some of these preliminary cultural practices that we anticipated would be necessary in order to make machine harvesting go.

We presented this data at Tomato Day here on campus, we presented it at our local county meetings, and one of the biggest items we did in this transition period was to present information at meetings called by the machine manufacturers, Blackwelder, FMC, Button. Blackwelder held a couple of meetings a year for about

Zobel: positive and not negative.

Actually, I look at this mechanization picture as a three-way deal. You had the tomato, you had the machine, then you had to have the production procedures. My part, I think, was mainly in the production procedures. In the early stages, two farm advisors--Ray King in San Joaquin County and myself--started to put out a series of newsletters. This was another method of getting information in front of the growers, this periodical newsletter. The information, apparently, was good because we had a request then from the University to put this into a bulletin. So this was where the how-to-grow-for-mechanization bulletins got started.

Dickman: Does this predate the Blackwelder publications?

Zobel: Yes, most of this predated theirs. Because of those newsletters Blackwelder and FMC Corporation and Button Machine people asked us to present this information to their potential clientele, the people that they were trying to sell machines to. We pretty well put this in a package, then we presented this information to the machine manufacturers' audience.

Dickman: Would you sum up the cultural changes that went with growing the machine tomato?

Zobel: Well, these cultural practices were very definitely different. We no longer could transplant tomatoes because it took a high plant population per acre, and also we shifted to various dates of planting. You couldn't plant them all at one time; four or five planting dates had to be made during the year in order to stretch out your harvest period to get full utilization of your machines. You can't handle the crop if there are too many tomatoes ripe all at one time.

Dickman: Planting different varieties?

Zobel: No, the same variety but different planting dates. The tomato that they have for machine harvesting is what we call a positive tomato--you plant it, it comes up, it flowers, it will set fruit, and then it will mature. It does this under a wide set of temperature and climatic conditions so that you can plant it on a date and be sure that it was going to harvest about on a certain date.

We worked out the spacing procedures, those that produced the highest yields and the best quality fruit. But the main cultural practice that the growers needed to recognize was to create as much uniformity in their field as possible: flat, uniform height of bed and keep it as flat as possible to minimize the amount of dirt that is going to get into the machine. The irrigation procedures had to be better. The other angle that we kept stressing to the growers

Zobel: was to think of the end point, the harvest. That's the key--that's your target! The harvest date. You may have to follow additional procedures during the cultural operation, during production, but the target point is harvest. If you can have uniform, perfect conditions at harvest, you're going to make yourself more money because it's going to minimize the expenses of harvesting. Then you're going to have better quality fruit, too. There were actually two main things that we really stressed in all of our production procedures: uniformity, and the end point--harvest.

Dickman: What about irrigation of tomatoes and your work and experience with this phase of tomato production and mechanization?

Zobel: Irrigation practices and management are the most important factors in tomato production. For a number of years I did considerable work in this phase of tomato production. There were two forces at work that stimulated my test plot work in this field or area of production. At first, the influencing factor was the information published by Dr. John Lingle, veg crops, UCD, and his coworkers which showed that irrigation of tomatoes could be terminated at thinning time and produce normal crops. The research work was done on campus in a Class I soil with little or no compaction layers. None of the active production fields have similar uninhibited soils. I just couldn't believe this would work in growers' fields. I wanted to check this research information against growers' practices in growers' fields. Just how much of the information could be used in production agriculture? Processor field men and processing management were accepting the nonirrigation information. This information needed to be checked quickly before it became finally a part of company policy. Historically, once a management decision gets on a memo pad, the policy is difficult to change.

At about the same time, there was developing an interest by the processors in paying for quality. Processors were suggesting a method of payment for quality similar to the method used for sugar beets. Very early tests indicated that irrigation practices had a strong influence on quality--particularly soluble solids. Unfortunately, there was an inverse correlation between irrigation and quality. With more irrigations, yields were higher but soluble solids were lower. After the first few irrigation test plots, it was rapidly determined that growers had to irrigate much more than the UC irrigation information indicated; that is, if they wanted economical yields. Most of the subsequent irrigation test plots were to determine how to manage irrigations to maximize production for both yields and quality of raw product--a search for the happy medium.

After considerable work and after considerable publicity through meetings and newsletters, procedures were fairly well established and

Zobel: growers were going along with practices for improved quality. Unfortunately, processors didn't continue with the philosophy of paying for quality. Growers rapidly shifted back to producing for tons only. Why shouldn't they! They were getting paid for tons only.

The Sacramento Valley tomato production acreage continued to climb while California tomato acreage declined overall. Obviously, the processing industry liked the quality they were getting from Yolo growers.

A side benefit from the irrigation trials is that growers have used the research information to minimize irrigation problems. Growers have shifted to using an every-other-row irrigation practice on fields that have potential problems from overirrigation. In general, growers have become much more aware of their irrigation practices. Irrigation procedures in general have improved. Growers still make irrigation mistakes, but now we have an answer as to what happened and how to avoid similar problems in the future.

This irrigation work was an important part of the successful production practices for mechanization of the tomato industry and irrigation still is.

Working With The Processors

Dickman: In addition to working with the growers and with the harvester manufacturers, did you have anything to do with the canners?

Zobel: The canners are an interesting group. They were resistant to machine harvesting from the start. It was a hard-sell program to get them to accept machine harvested tomatoes. They did not want any part of it. They are generally resistant to change. Going way back into hand harvest when growers shifted from the early Santa Clara canner to Pearson, which was a smaller plant; they said they couldn't use the Pearson variety. "It's no damn good, the industry is going to be ruined." But Pearson was forced down their throats because this was what the growers could grow and make money at, and labor would pick it, so they were forced to accept Pearson.

Dickman: Pearson is one of the smaller vines?

Zobel: Yes. It was a step in the smaller vine direction. Then from Pearson, Jack Hanna started to come in with some of his varieties, which

Zobel: again were smaller vine, and they squalled their eyes out: "We can't use this variety; it's no darn good." But they were forced to accept machine harvest tomatoes or they would have no tomatoes at all. Three or four years after we were fully mechanized, Del Monte people came out with a contract to pay five dollars a ton less for machine harvested tomatoes. The growers just said, "Well, we'll ship our tomatoes someplace else," and Del Monte was forced to get in line. This was an indication of the resistance processors showed towards the change to machine harvested tomatoes. They objected to the smaller size fruit too. Changing the tomato meant they had to change their procedure in the processing plant, this was "rocking the boat."

Fortunately we had the grower coops, Cal Can [California Canners and Growers] and Tri-Valley [Growers]. A lot of the grower thinking was plugged in there. This more or less forced the rest of the processing industry to roll along with it too.

Dickman: And yet, before the machine, hadn't some in the processing industry been thinking seriously of moving out of California?

Zobel: This was because of less expensive and plentiful labor. They were thinking about going into Mexico and other areas--Italy, Spain, South America--where labor was plentiful, and they thought they could pick up there where they left off here. But when they get into these foreign countries, they have other problems.

The Labor Situation

Dickman: Did you have any contact at all with the laborers themselves?

Zobel: Very little contact. There was always a chance you would create a situation where a crew would get disgruntled and walk off a field. Since we were only guests on these growers' ranches, there by permission only, (and it's a tenuous situation at best), we avoided labor contact as much as possible. When we wanted to do something with labor, we worked through the owner or the labor boss and he related what we wanted. In other words, we avoided any labor contact at all.

Dickman: Can you characterize the change in the composition of the labor force that took place when machine harvesting replaced the hand harvest?

Zobel: Yes. There was a complete change in labor from hand picking days

Zobel: to machine harvest days. During handpicking we were using a lot of braceros. Young men, physically fit, able to pick up fifty-pound boxes; many times I've seen them pick up two fifty-pound boxes of tomatoes and trot with them to the end of the row and stack them.

Dickman: When the bracero program was being phased out many of the growers were desperate to find other sources of hand labor?

Zobel: Yes, they were forced to bus in every source that they could find. Here in the Woodland area they were even hauling winos from Stockton. In order to qualify for the use of braceros--they had to dry up all the local sources before they could use braceros. Toward the end of the bracero program they even had to go to the South and East and recruit in Louisiana and Mississippi, and import them out here--pay their bus fare out here. The minute they landed, many disappeared in Oakland without working one day, so this program rapidly went down the drain. From those days, we have now shifted into utilization of local labor: housewives, high school kids, physically unfit people that could not physically cut the mustard--we're now using them on the machines. We are using labor that the rest of the labor market casts off.

Much of our present machine harvest labor is nonprofessional agricultural labor. It's temporary, part-time. They earn a little money and then quit. Kids earn school money; mama's out there to earn some money to buy the kids some clothes to go to school, or she has a target of wanting to go to Lake Tahoe for a week and she earns some extra money this way. It's supplemental money, rather than their depending on making a living from it.

Tomato Growers Association

Dickman: Did you deal directly with the Tomato Growers Association as such, or was it entirely with individual growers?

Zobel: We always have contact with the association. It's a good working arrangement--they have their function in the industry, we have our function. When we want some information from them, we go contact them; if they want information from us, they contact us.

Processing Tomato Advisory Board

Dickman: How about the Processing Tomato Advisory Board?

Zobel: This is relatively new; this came in just a couple of years ago. Right now I'm utilizing it. I have several projects funded by the Processing Tomato Advisory Board. The Processing Tomato Advisory Board funds come from the tomato marketing order. I've used it as a source of funding to get some jobs done that we haven't been able to do before.

Dickman: What jobs are these?

Zobel: The first thing that we put together was a laboratory to look at the quality of processing tomatoes. Prior to developing this lab, each individual farm advisor who was running a variety trial or wanted some quality work done had to go to some source other than the University to beg to get his samples run--to run quality determinations. Each lab uses a different procedure and comes up with different answers. None of our data could really be compared. In other words, what I was getting here in Yolo would not be comparable with what Ray King was getting in San Joaquin, or Phil Osterli was getting in Stanislaus, or Don May was getting in Fresno. Each one of us used a different lab, and so data was difficult to compare. This was why we approached the Processing Tomato Advisory Board and told them what we would like. They funded us. We worked with Al Stevens, who runs a lab here on campus. We bring our samples in, and on all the samples he uses the same procedure. Now we can compare data from various production areas. Now we're utilizing the extension's computer center to plug this data in. The information developed is more valuable. This is one of the examples.

Now the other thing that I'm running right now, using Processing Tomato Advisory Board money, is what I call my degree hour project. This project is based on accumulating growing temperatures (how many degree days or degree hours it takes a tomato plant to go from emergence to harvest). Hopefully, we will find out how many days it takes to mature a field, and then the grower should be able to state: "Well, I've got so many more units to accumulate, then I'll be ready for harvest." He will predict his harvest date much closer than he can at the present time. This, hopefully, will smooth out some of the peaks and valleys in processing that we now are faced with. The processor also would know he's going to have so many acres. He's going to say, "All right, I've got this many acres," and will begin to look around for help. "Where can I shift some of my tomatoes to, so I won't lose them, so that the grower won't lose them." I think it will help the industry if we can get this concept off and rolling. I see no reason why we can't if we

Zobel: can show where the problem areas are. The tomato industry is not dumb. You point out the problems and they'll solve them.

Dickman: Since the development of the machine harvester the number of tomato growers has diminished rather substantially?

Zobel: Yes.

Dickman: Why is this?

Economic Factors

Zobel: Several factors went into the falling in numbers of tomato growers. One is the amount of money necessary to mechanize. No longer could they grow forty acres of tomatoes. You had to grow enough acres to utilize the machine. This meant that during the beginning stages we considered 160 acres required to justify a machine. Now we plug in the figure 200 acres per machine. Well, if you buy one machine, you also have to buy or rent the other component machinery to go along with it to produce these tomatoes. In order to utilize the rest of the machinery, you had to have more acres. This then brought things to where most growers developed operations around three machines to have an economical unit for machine harvesting; to handle the fork lift, to have the foreman out there and the mechanic on standby and all this type of thing, to have a good working unit--it takes about three machines. This eliminated the weak, the meek, and the one that was not willing to make any transition. The grower that refused to grow tomatoes differently for a machine than by hand fell by the wayside. Growers that were making mistakes fell by the wayside.

We have now developed an industry of specialists. Nearly all the tomato growers are specialists. Very few of them grow tomatoes as part of one crop of the general crops operation. There's a few growers that are generalists, that grow many other crops besides tomatoes, but usually they have a foreman that handles strictly the tomato crops--in other words, it's one industry within an industry. Actually this has worked down to specialization completely.

During this time of machine development, we were running cost studies: comparing studies of costs of hand harvests versus machine harvest. Information we were looking for was: where were the biggest expenses? where were the places that they should cut down? where could they cut corners to make this operation more feasible? These studies helped the growers find the weak points, places they had to stress. I consider this was an important factor. We still

Zobel: get a lot of demand for our cost studies.

Dickman: Are there ag economists in Ag Extension?

Zobel: I've worked nearly all of my cost studies with the guidance of Phil Parsons in ag econ, an extension specialist. He was consulted mainly as a crutch to lean on, to keep me going in the right direction. Phil has been very, very helpful.

The Button Machine

Dickman: What have we omitted?

Zobel: There's one thing that we've omitted, and I don't know whether you'll ever get it on tape: this is Bob [Robert Leslie] Button's impact on mechanization of the tomato industry. I feel somewhat responsible, mainly as a needle, to keep him moving, to keep him headed in the right direction, to keep him going. He used me as a sounding board for thinking. Bob may have seen some of the prototype tomato harvesters that were being put together here on campus, and he decided that he could put a machine together himself. So he went back and on his shop floor drew in chalk some pictures of what his thinking of the machine would be like. He took an old self-propelled SP-123 harvester, grain harvester, cut it back to the framework and started building. He built his primary harvester right there in his machine shop on his ranch--piece by piece, chalk, drawing, cutting with a torch, and he came up with his original harvester. That harvester was highly successful.

Dickman: What year was that?

Zobel: That was 1961; and it was a highly successful machine; he put many tons through it, and he really spark-plugged the industry to get off the dime. One thing that did happen--it may be a sensitive area, but it's something that happened--Button put his machine totether, and Blackwelder felt that he was infringing on patent rights that the University had leased to Blackwelder, so Blackwelder was on the University attorneys to stop Button from developing his machine. It didn't stop him. What it did was to force Bob to change from the shaking mechanism (which the University was using in their patent procedures) to a different shaking mechanism, and actually this was a benefit because Bob's machine currently is one of the top machines in the state--it made a better machine out of it rather than degraded the machine.

I don't know how much credit history will give Bob for his part

Zobel: in machine harvesting, but he deserves a lot of credit. Right now he is promoting, sparkplugging, the electric eye for sorting, and he has this pretty well worked out. I think most of his personal machines will be electric eye machines this year. Also he is working on an experimental new type of electric eye in his shop out on his ranch. Much of this is done on his own ranch. He's quite a character, quite an individual.*

The Farm Advisor: Between the Rock and the Hard Place

Dickman: Mr. Zobel, a farm advisor has to try to be all things to all people, and yet he has to call the shots as truthfully as he can. How in the world can you keep everybody happy? Or do you?

Zobel: There's no way you can keep everybody happy; you have to call your shots as you see them. Some people get unhappy, some of them get down right mad, but if this is what you think the situation is and this is what the situation calls for, you tell them.

Dickman: Without mentioning any names, can you give some examples of difficulties that you've been in?

Zobel: Oh, one interesting one that had me quite bothered at the time--but I was resigned to it: I couldn't sleep one night when I was worrying about tomato mechanization, so I formulated a newsletter in my mind, and before I stopped to think about what I was doing, I had it in print and sent it out. Some people in the industry took umbrage at what I had said, and I came very close to getting the sack. This is one incident.

Another incident was when some growers asked me to come out and look at their field, and tell them what I thought. This happens all the time; but in this particular case my thought was in conflict with what a processor was telling them. There was some name calling and complaints from higher up. I had sufficient sound information and nothing really ever came of it.

Everyday the problem is being diplomatic and yet being positive--how do you tell a grower that he's made a mistake? How do you tell a

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*About six months after this interview took place, Bob Button, died in the crash of his private airplane near Davis, December 3, 1975, at the age of forty-nine.

Zobel: grower he's goofed, and make him like it? So, you have to be diplomatic, and yet if you don't tell him, you're not doing your job. It gets to be a little touch and go a lot of times. If you back off, make him happy for the moment, in the end you lose. In looking around at fellow farm advisors, there's a number of them that you can point out who are what I call weak sisters, and the industry--the growers--have no confidence in them. If you're really doing your job, you've got to stick your neck out.

Dickman: Thank You.

[After reading the transcript Mr. Zobel wrote the following comment:

The enclosed interview fairly well scratches the surface of what went on and during the shift to mechanized harvest of processing tomatoes. So much of the forces in motion were incidental to the general movement in this direction that it is difficult to pinpoint and pick specifics that clearly define the change.

One could describe it as a migration toward an end point. There were many people in this movement toward mechanization--physically participating and mentally. Our part perhaps would be better described as heading the movement and keeping it moving in the right direction. If certain practices or principles were developing that appeared to be out of line and the industry was to economically have to learn the hard way, we tried to get these directions changed. There was some learning the hard way but many more were avoided or the economic blows softened.

We made many friends along the way and a few enemies but the shift to mechanization was swift and smooth. Much easier than most thought possible.

It was not a single effort but a coordinated effort of a number of people.]

ROY BAINER

Tomato Research

Bainer: Now, when it came to tomatoes we were kind of the laughing stock around here when we mentioned that we were going to work on the harvesting of tomatoes. The tomato, as it was known then, was a perennial that continued to set fruit until frost. The crop didn't ripen uniformally, and therefore it was necessary to go in and make multiple pickings; at least two and sometimes three. And by the time you made your last picking these plants were lying on the ground.

It was very evident that if you were going to do this job you were going to have to have a different tomato because you had to have a plant that was of determinant type that set fruit and ripened over a short period of time. Jack Hanna of vegetable crops department tackled this problem. I'm told that Albert Jongeneel knew Jack because he had lived on Ryer Island and had done a lot of asparagus work there. Jongeneel was the man who was behind the development of the sugar beet harvester. Well, after the war, Jongeneel told Jack, "If you want to make a great reputation for yourself, you'll come up with a tomato plant that can be harvested mechanically."

Dickman: So he reached that idea independently?

Bainer: That's right, independently. We had reached the idea that we were going to work on these various crops on our own.

Dickman: Including tomatoes?

Bainer: Including tomatoes. So Jack then got interested from the other side and we had Lorenzen interested from our side. Well, Jack started out (I've heard him give this talk, I hope it's been recorded someplace) with the little Tom Thumb variety of tomato. He had one of those original plants that he started with, in a pot,

Bainer: as a demonstration, when he gave the talk on how he developed this tomato.

Dickman: Let me interrupt you just a moment. Jack Hanna and Coby Lorenzen of ag engineering, were working together now as a team?

Bainer: Yes.

Dickman: Deliberately on this project?

Bainer: Yes.

Dickman: And that you as chairman of the department had assigned them?

Bainer: That's right.

Dickman: Wasn't this one of the first times that these disciplines had been brought together--the geneticist and the ag engineer?

Bainer: Yes, I would say that--I have mentioned the grain sorghum work back in the twenties, but the engineer wasn't involved with the plant breeders. The plant breeders went ahead and did it. And then they invited the engineer to come in, and to me, that showed what a plant breeder could do toward changing a form or shape or characteristic of a crop to make it adaptable for mechanical harvesting.

Dickman: And to an extent you worked with a plant pathologist on the sugar beet?

Bainer: Oh yes. We had a reputation here of working with people--we worked with the botanists on the beans. No one was changing anything much, you see, until Jack Hanna got into the act, and this I would say is an outstanding example of cooperation with the biological people. Well, anyway, Jack started out with the Tom Thumb tomato variety which had a couple of characteristics that he wanted. One was that it was a kind of determinant plant and the second was the tomatoes ripen up more uniformly. When he crossed it with other canning varieties he started coming up with some promising characteristics. All the while he was working, of course, Coby Lorenzen was working on a machine. The breeding program, as I recollect, took about eleven years, and it began to show very excellent progress in the final two or three years.

And then, of course, the situation that really set it off was when Congress terminated Public Law 78 in 1964 which had permitted the importation of foreign labor. And when Secretary Wirtz started to enforce this--now, Wirtz got the blame for this change, but he was just following orders. Well, all of a sudden it was evident

Bainer: that we weren't going to get labor from Mexico for picking our tomatoes. The best estimate that I've seen was that 85 percent of our canning tomatoes were picked by Mexican nationals! And if you withdraw that source of labor supply you're just going to be in trouble because you couldn't recruit domestic labor to do it. There were attempts to. They even had training schools at Davis to train people how to pick tomatoes. The pickers lasted anywhere from four to eight hours after training, when they really got out there where the work was. And you just couldn't keep a crew.

Well, there was a little liberalization of this order that made it possible to bring in some Mexicans for a year or so. Governor Brown called a meeting on the tomato situation and invited Coby Lorenzen, Kelly* and me. And there were others there. He wanted to know what we were going to do now that we weren't going to have Mexican nationals.

Well, I told the governor, "We're working on this problem, and I would suggest that you persuade Secretary Wirtz to phase this program out over a period of three years. And I think at the end of the three years we'll have something that'll pick the tomatoes." Well, I don't think the governor believed that this would happen although he did, as I say, get some liberalization on labor importation. But, you see, the handwriting was on the wall.

To get back to the research story: In order to get seed you started out with single tomatoes; you had to start producing seed. So Jack Hanna started to grow tomatoes in Mexico, and in that way he got two seasons. He could go down there and raise a crop of seed and another crop of seed here.

I remember that the advisory committee of the Tomato Growers Association asked to come here for a meeting to see where we were. They were getting scared. After the meeting was over, they were quite encouraged by reports that Hanna and Coby gave them and they asked to see the prototype of the harvester. They had never seen it. And Coby showed them this prototype harvester. Well one of the Heringer boys (there's a group of Heringers that are big farmers down in the Delta) saw the machine. I think it was Les Heringer that was there. Well, when he saw that machine he said, "I have left one row of a paste-type tomato; these are little pear-shaped tomatoes. We harvest these by shaking them off. We simply pull the plant and shake it over a blanket. We don't pick them individually. And when I took my last load out of the field there was a

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*Clarence F. Kelly, Director Emeritus, California Agricultural Experiment Station.

Bainer: row left. We didn't have room for the row so we are going to disc it up. I would like to see that machine tried on those tomatoes. I think it'll handle them." He was a farmer, you see.

He told us where the field was and we told him we would bring the machine down the next day. Well Coby and I went down to the field after the meeting. We thought we should look at it. We thought it might be a wild-goose chase to take the machine down there. We weren't familiar with this particular strain. This made up maybe 10 or 15 percent of the total production; it was a different tomato. So we went down and played around with those tomatoes that evening and came to the conclusion that it did show some promise.

Well, we made a deal with Heringer. We told him that we'd bring the machine down there but we didn't want an audience. You see, this was just a prototype and if it failed we didn't want a lot of witnesses. Well, when we got down with the machine the next day there were about twenty farmers there. So the word had got around. Unfortunately the most important future man on this team was not there; that was E. Blackwelder. We never thought about having Blackwelder come. This machine just surprised everybody. And the next thing we knew Bob Heringer went to Blackwelder and ordered a machine. Well Blackwelder had no idea what the machine would cost, so he was going to build it on a cost-plus basis; the cost of all the parts plus a little for Blackwelder with no guarantees. He said, "I can't give you any guarantee that this machine is going to work." And then he, of course, saw the prototype. We loaned him this machine. He took it to Rio Vista and started working on a harvester.

Well this harvester was coming along very well. So I went to the Statewide Dean of Agriculture D. G. Aldrich. We were thinking, "Here a farmer's going to have one of these machines, and we don't even have one to test out perhaps fifty varieties of tomatoes that Hanna had under cultivation." All of them had shown some promise. So I asked Dean Aldrich for enough money to buy a harvester (have Blackwelder build us one when he was building one for Heringer). And boy, getting money was almost impossible. I don't know why we were so hard up then; this was before our austere period in the University.

I think Aldrich thought it was kind of a wild idea anyway. But finally Aldrich said, "Do you suppose Blackwelder would take a down payment of 50 percent and have a little bit of an investment himself in this experimental unit and next year we'd pay the other 50 percent?" Well, Blackwelder was working on a pretty close margin all the time and he wasn't too warm to this idea, but he finally said he'd do it. Well, to make a long story short, I reported back

Bainer: to Aldrich. He had found the other 50 percent needed and we paid Blackwelder the whole amount when he delivered the machine.

Well, this was a very wise move because it gave us an opportunity to try a commercial unit on a whole group of varieties. Well, Heringers had that machine that first year and took out twelve hundred tons of tomatoes. This was the beginning. It gave farmers some confidence. Well, Blackwelder made too many machines the next year; he made about twenty-five units. We tried to hold him down because we felt there would be a lot of bugs; I mean, it was a brand new idea and we were working with a perishable crop. Well, he could have sold many more machines but he held the line at twenty-five machines. They had a lot of grief with them. So before the next season he took all twenty-five machines back and he rebuilt them according to the information learned in the tomato fields, and he didn't build anymore the second year.

Dickman: Now, were these machines used to harvest the kinds of tomatoes that Hanna was breeding?

Bainer: Yes. They wouldn't work on the standard varieties. This was a new variety--F 145 I think was the number. A limited amount of this seed was made available.

Dickman: So Hanna had selected one out of the several varieties he was working on?

Bainer: Well, he had selected one strain, what he called his 145 which was just a system geneticists use for numbering everything, and it still goes by number. I don't think it has any other name. And, of course, the seed companies are now producing the seed.

Dickman: What were the characteristics of that strain that made it--

Bainer: Several things. First, it was a determinant plant.

Dickman: What does that mean?

Bainer: That means that it grows to a certain height and quits growing. It has a determinant growth characteristic. It sets its fruit very uniformally and ripens up over a three-week period. If you started harvesting early in the three weeks you'd get more green fruit; if it was late in the three weeks you'd get more overripe fruit. But there was a range of three weeks that you could harvest. This was important. And then, of course, the new tomato was smaller.

Dickman: Was it shaped the same?

Bainer: Yes, that particular one was shaped the same--smaller with a tougher skin.

Dickman: How about the look of the plant itself?

Bainer: Oh, it looked like the regular plant.

Dickman: It didn't grow upright?

Bainer: Oh, yes. It grew about as high as this table [about 2-1/2 feet].

Dickman: But did the vines have a tendency to lie on the ground?

Bainer: You went in and cut the vine at the height of the yield. When you took these tomatoes off you simply severed the vine below the ground level and took the whole plant in the machine. That was the end of the vine. And you used the same principle to take those tomatoes off that you used to separate grain from straw in a combine. There was a shaking table like a straw rack in a harvester. So, another use of the combine principle was to separate the tomatoes from the vines. And then, there was a provision for conveying the fruit past workers who threw out green, damaged, and misshapen fruit. What it really amounted to was about twelve people now did the work of sixty. But the work on this machine was so easy compared with the work of handpicking that women could be used for sorting.

Dickman: And how was the efficiency compared to hand labor?

Bainer: They got acceptable yields from these new varieties. It wasn't anything uncommon to get yields of twenty-five, thirty or thirty-five tons per acre in one picking. And that was as good as the hand method. There was lots of waste in the old method too, because between the two picking dates there would be a lot of tomatoes that would spoil, or were overripe; so that you had a big loss then. But with this system the losses were no greater than with the hand operation. Hanna was very fortunate in being able to develop a yield into this new variety which made it economical. But when you were out looking at one of these machines operate, you'd be appalled by the waste. I hope some day that they will be able to utilize this green fruit in some other way--pickling or chow-chow or catsup. But so far they have harvested only ripe tomatoes.

Dickman: Where are most of the canneries located?

Bainer: Sacramento, Woodland, Davis and San Jose; even down at Fullerton. The interesting thing is when I talked with Virgil Wodika of Hunts at Fullerton--this was three years ago--they had grown tomatoes out on the desert near Blythe in the Palo Verde Valley on the Colorado River, and had to haul those tomatoes all the way to Fullerton

Bainer: which is over two hundred miles. They harvested at night when temperatures had cooled off and put them on the road in bulk bins, a thousand pounds of tomatoes in a bin, and hauled them all the way to Fullerton. I asked Wodika how they compared with tomatoes they were getting locally. He said, "The very best tomatoes we processed came from the desert." I'll talk about the work Mike O'Brien has done in bulk handling of tomatoes which helped make this long distance transport possible.

Then came the problem of how are you going to handle the tremendous volume of tomatoes that come off of the machine? So, that brought in another member of ag engineering, Mike O'Brien, to work on the bulk handling of tomatoes, and not only that, the sampling for grading before the tomatoes went to the cannery. They had to be carefully unloaded, and he had several mechanical problems there. Then there was a mold problem that developed in the large bulk bins. That brought in another team member to work on control of molds. I've omitted another very important member of this team, and that is the food technology people who came in the picture early to evaluate the product from the machine. In other words, you had to be able to come up with a finished product that was as good as we had had before. Even before they went as far as the farmer and the manufacturer, food technology was working with Hanna and Lorenzen here on campus in which they actually canned the tomatoes from the machine in order to determine the amount of solids and quality. They went clear through their taste panel to give their evaluation. So, you can see that this was all very important, and then later on the economists came in to make an economic study of the deal, and this was handled pretty much at the farm advisor level. See, farm advisors came into the picture, not from the machine development or the variety development, but the production angle.

Dickman: You said earlier that O'Brien was able to put these tomatoes into four-by-four-by-four bins without crushing. How was he able to do that?

Bainer: I think it was because the actual pressure in these bins is carried on the walls. I don't think it was so much the tomatoes as the peaches in these big bins that had the problem with roller bruise. The tomatoes just kind of settled down in the bins. Now they've gone from bins to bulk loading in trucks. The unloading is done into a tank of water to prevent bruising.

The Patent Board gave Blackwelder an exclusive license for five years and then extended it for another five years. But in the meantime other manufacturers came into the picture in a rather small way. The fact that Blackwelder had the head start gave him the cream of the business. He sold a large number of machines,

Bainer: and once he had saturated the market, there wasn't much of a market left.

Now, you might say that we've been partial to Blackwelder, but this is not true. Everytime the Patent Board has had a machine to market, they have tried to involve people that they think might be interested. In the case of the tomato harvester, others were questioned as to whether or not they might want to get into the act. The International Harvester Company at Stockton and Massey-Ferguson at Fowler were invited to consider both the tomato and the grape harvester. Of course, the problem is that there's not enough volume in such items as these special harvesters to really be of interest to many of these companies. You have to have a small manufacturer like Blackwelder, and I hope we'll always have a Blackwelder in California to handle these less attractive items.

Now, there's something else I've noticed along this same line, when I was at the International Harvester Company seminar twenty years ago. It was about the time that International was moving into cotton harvesting machinery. I mentioned to [International Harvester] President McCaffrey that I had seen a new model of a cotton picker made by John Deere. And I said, "It looks very similar to yours. Did you license John Deere to build one like yours?" He said, "In some instances we do." And I found out later that they do have a kind of agreement, a small license fee for the use of patents. He said, "When we bring in a new machine, we maintain exclusive production for two years, and then let other people build it. And with a two-year headstart if we can't pick off the cream we don't deserve to be in the business." He told me another very interesting thing. It was a result of a question I asked him. I told him that years before a small company, by the name of New Holland Company, came out with an automatic tying hay baler, and they used twine; and this was the first real successful automatic tying baler on the market. I said, "They've got quite a headstart over everyone else." And Mr. McCaffrey said, "Yes, they did. They didn't even have a knotter to tie the twine. We sold them the knotters. And pretty soon they had their business up to eighteen or nineteen thousand machines a year and we were selling them the knotters. We thought we'd better get into this business." And so, everybody and his brother moved in on automatic tying balers. Then they got into wire tyers or twisters or whatever you want to call them. But a small company lead the pack. It wasn't any bigger than Blackwelder at that time. Well now, Sperry Rand has bought them out. It's a company that's doing a big haying machinery business. They've made some other developments like the hay conditioner which really proved to the world that there was a demand for hay conditioners. Again every farm machinery company is in the act.

Bainer: A little sidelight on this tomato picture: I served on the Agriculture Board of the National Academy of Science for about five years--I was the only engineer on this board. We had frequent meetings in Washington. There were some very wonderful people on this board: directors of experiment stations and deans and geneticists, etc. I remember one in particular, Dr. N. J. Volk, who was the director of the experiment station at Purdue; he, of course, was aware of what was going on around the country. And at one of these meetings he said, "Well, you know, the work that you people are doing in California is going to be so competitive that we will no longer be able to produce tomatoes for canning. We can't compete with you." You know, it surprised me. I said, "Well, listen. In Indiana you can grow tomatoes for half of what it costs us to grow them in California. You don't have the irrigation problem, you don't have the insect problem, you don't have the high-land values, and all those things that go with it. Your costs would be way below ours." "Well, sure," he said, "I'll agree to all that. But, the big cost in the tomato is picking it. And if we can't use a machine, we can't compete. We can't depend on a machine because we can't depend on the weather. We may get a rain at the time the tomatoes are ripe; we can't put that machine in there because you can't 'mud 'em out' and we'd just lose them. You can put handpickers in there after a rain and pick them, but you can't put a machine in there." And he was right.

Dickman: What's happened to the tomato business in other areas of the U.S.?

Bainer: Well, they're not competitive now. There have been some tomato harvesters used back in New Jersey, I'm sure. But it's a gamble on account of rain. In California we normally can get our tomatoes out, without rain. Now, of course, if we get rain we're in just as bad shape as they are.

When we really got going in this tomato production there was an overproduction. It was so easy to produce, and I think we had over two hundred thousand acres. The canneries had contracted more than they should have. You see, tomatoes are a contracted crop. You don't grow them unless you have a contract. But the thing is that we had an overproduction and then a cutback.

Dickman: What percentage of the total tomato crop goes into canning, most of it?

Bainer: Oh yes, a high percentage of it. California, with this mechanization, is the main producer of canned tomatoes. I don't know exactly but I would say somewhere between 75 and 85 percent of all the processed tomatoes in the United States are produced right here in California. So we did maintain an industry which was very important

Bainer: to California, by this mechanization. And people do not realize how many jobs depend upon the tomato. When you begin to think about all the people down the line that are involved. You have the transportation from the raw product to the finished product which involves trucking and the railroads. This stuff goes all over the United States. You have the people involved in the processing, in the canneries, the steel makers of the can, the wrappers and labels on the can, the printing, advertisers, bankers, etc. I figured this industry was worth half a billion dollars a year to California and we were about to lose it.

I failed to mention another facet of this. When it was announced that we weren't going to have labor, the processors began to look elsewhere for a place to grow tomatoes. And they began to investigate Mexico because they can grow tomatoes in Mexico. I went to Guatemala on a consulting trip and I found out they'd been down there checking on the possibility of growing tomatoes in Guatemala and processing with local labor. We almost lost this industry--it was just one of those things that was timed just about perfectly. Same with the sugar beet research. We started with sugar beets in '38, and the war came along in '41. By then we were far enough along that we could accelerate the program to compensate for lost farm labor. So I think the forward look that was taken in the late forties was very important in having something ready when the problem became acute. This is where the University is in a key spot, and I think we're losing some of this attitude right now. I don't think we're thinking as aggressively on problems that might come. As I say, I can still hear people laugh when we talked about harvesting tomatoes, but they had no imagination and no concept of how things could be changed to make it possible.

Dickman: That's the old story? "Without vision the people perish."

Bainer: (Laughter) That's right.